

apc

Sep 2019
Issue 471

WIN!*



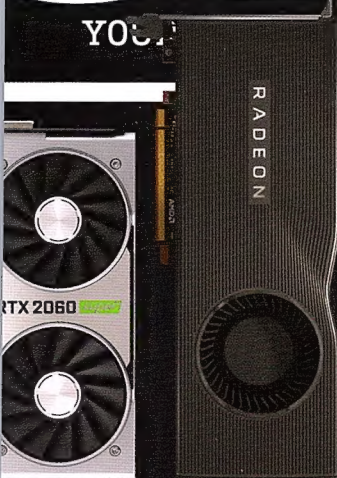
THE \$3,000
CUSTOM APC & WD
PRO-MOD PC!

* COMPETITION OPEN TO AUSTRALIAN
RESIDENTS ONLY. LAST ENTRIES
ACCEPTED 8/9/2019

+

BEST 1080P
GAMING CARD

NVIDIA GTX 1060 & 1660
VS. AMD RX 590



AMD 5700 & XT
VS. NVIDIA SUPER
CARDS
THE GPU WAR GOES NUCLEAR

AMD
RYZEN

SUPERCHARGED!

THE HOTTEST REVIEWS OF THE YEAR

NEW AMD
RYZEN

+

> THE ONE WE'VE BEEN
WAITING FOR
> IS INTEL #2 NOW?



AMD X570
MOTHERBOARDS

+

> NEXT-GEN PLATFORM
> SUPERFAST SSDS



MEMORY
BUYER'S GUIDE

> FIND YOUR PC'S SWEET SPOT
> 8 KITS TESTED

FUTURE
PUBLISHING
AUS\$9.95 INC GST
NZ\$10.90 INC GST
PRINT POST
APPROVED: 100000179
ISSN: 0728-4415



DIY PROJECTS

TURN AN OLD
PC INTO A NAS

RUN RETRO GAMES
ON ANDROID



PACKED WITH
REVIEWS

RASPBERRY PI 4

PLUS, RAZER BLADE PRO 17,
OPPO RENO 5G, DELL G7 LAPTOP,
OCULUS S, SEAGATE 510 SSD, NETGEAR
NIGHTHAWK X6, MOTOROLA G7,
GIGABYTE AERO OLED



4G LTE CAT4 Routers

Mobile Internet Solution for Small-to-Medium Businesses

DrayTek
Aust & NZ

www.draytek.com.au

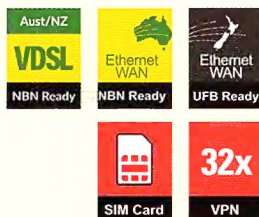
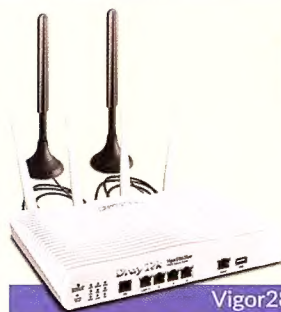
High Speed: up to 150Mbps download and 50Mbps upload

Supports 4G LTE bands: B1/B3/B4/B5/B7/B8/B28/B40 (Bands vary pending models)

Great coverage in Australia and New Zealand

- Provision of Internet access on public transport such as coaches, buses, trains, freighters, etc.
- Temporary installations such as disaster recovery and emergency situations, exhibitions, sporting events, etc. where Internet access is required for a short period.
- Quick setup for remote location or new branches waiting for xDSL/Ethernet WAN (e.g. NBN).
- Multi-WAN series LTE routers (i.e. Vigor2862L, Vigor2926L) support Load Balancing and Failover functions.
- Single WAN series LTE routers support failover functions between xDSL/Ethernet/LTE connections for Vigor2620L, or between Ethernet/LTE connections for VigorLTE 200n.

Vigor2862L Series



Vigor2862Lac

- 4G LTE Multi-WAN router with SIM card slot
- VDSL2/ADSL2+, Gigabit Ethernet WAN
- SPI Firewall, 802.11ac WLAN
- 16 x VLANs, 32 x VPN tunnels (including 16 x SSL-VPN tunnels)
- Central VPN Management
- Central AP Management
- Support VigorACS 2 (Central Management System) for remote management

Vigor2926L Series



Vigor2926Lac

- 4G LTE Multi-WAN router with SIM card slot
- 2 x Gigabit Ethernet WAN ports
- SPI Firewall, 802.11ac WLAN
- 16 x VLANs, 50 x VPN tunnels (including 16 x SSL-VPN tunnels)
- Central VPN Management
- Central AP Management
- Support VigorACS 2 (Central Management System) for remote management

Vigor2620L Series



Vigor2620Ln

- 4G LTE router with dual SIM card slots (SIM slot 2 for failover)
- VDSL2/ADSL2+, Gigabit Ethernet WAN
- SPI Firewall
- 802.11n WLAN
- 2 x VPN tunnels (including 2 x SSL-VPN)
- Central AP Management
- Support VigorACS 2 (Central Management System) for remote management

VigorLTE 200n



VigorLTE 200n

- 4G LTE router with dual SIM card slots (SIM slot 2 for failover)
- Gigabit Ethernet WAN
- SPI Firewall
- 802.11n WLAN
- 2 x VPN tunnels (including 2 x SSL-VPN)
- Central AP Management
- Support VigorACS 2 (Central Management System) for remote management



i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ

www.i-lan.com.au

www.draytek.com.au

(02) 9838 8899

sales@i-lan.com.au

© Copyright 2019 i-LAN Technology Pty Ltd. All rights reserved.

Future Publishing Australia, PO Box 1077 Mount Street,
North Sydney, NSW 2059
Subscription enquiries: Please call CRM: (02) 8227 6486
Tel: (02) 9955 2677 Fax: (02) 9955 2688
Email: apcmag@futurenet.com
Web: www.apcmag.com

Editorial

Editor: Ben Mansill
Senior Journalist: Shaun Prescott
Journalist: Joel Burgess
Journalist: Harry Domanski
Journalist: Stephen Lambrechts
Journalist: Sharmishta Sarkar
Creative Director: Troy Coleman
Designer: Sharnie Swinnerton

Contributors

Alan Dexter, Sean Endicott, Craig Grannell, Christian Guyton,
Malindy Hetfeld, Kenny Hemphill, Andy Kelly, Stephen Lambrechts,
Carrie Marshall, Nick Peers, Les Pounder, Samuel Roberts, Nick Ross,
Tom Senior, Dave Stephenson, Alan Stonebridge, Mayank Sharma,
Chris Szewczyk, Tom Sykes, Nathan Taylor, Stuart Tonks, Mark
Wycislik-Wilson, Darren Yates

Photography

All copyrights and trademarks are recognised
and respected

Advertising

Group Advertising Manager: Cameron Ferris
cameron.ferris@futurenet.com

Management

Managing Director: Neville Daniels
Sales Director: Paul Marttila

Printed by Blue Star PRINT (NSW)

Distributed in Australia and NZ by Gordon and Gotch
www.gordongotch.com.au

ISSN 0728-441

We are committed to only using magazine paper which is derived from
responsibly managed, certified forestry and chlorine-free manufacture. The
paper in this magazine was sourced and produced from sustainable managed
forests, conforming to strict environmental and socioeconomic standards. The
manufacturing paper mill holds full FSC (Forest Stewardship Council) or PEFC
certification and accreditation

All contents © 2018 Future Publishing Australia or published under licence. All
rights reserved. No part of this magazine may be used, stored, transmitted or
reproduced in any way without the prior written permission of the publisher.
Future Publishing Limited (company number 2008885) is registered in England
and Wales. Registered office: Quay House, The Ambury, Bath BA1 1UA. All
information contained in this publication is for information only and is, as far as
we are aware, correct at the time of going to press. Future cannot accept any
responsibility for errors or inaccuracies in such information. You are advised to
contact manufacturers and retailers directly with regard to the price of products/
services referred to in this publication. Apps and websites mentioned in this
publication are not under our control. We are not responsible for their contents or
any other changes or updates to them. This magazine is fully independent and not
affiliated in any way with the companies mentioned herein.

If you submit material to us, you warrant that you own the material and/or have
the necessary rights/permissions to supply the material and you automatically
grant Future and its licensees a licence to publish your submission in whole or
in part in any/all issues and/or editions of publications, in any format published
worldwide and on associated websites, social media channels and associated
products. Any material you submit is sent at your own risk and, although every
care is taken, neither Future nor its employees, agents, subcontractors or licensees
shall be liable for loss or damage. We assume all unsolicited material is for
publication unless otherwise stated, and reserve the right to edit, amend, adapt
all submissions.

Privacy statement

If you provide information about yourself this will be used to provide you with
products or services you have requested. We may supply your information to
contractors to enable us to do this. Future Publishing Australia will also use your
information to inform you of other publications, products, services and events.
Future Publishing Australia may also give your information to organisations that
are providing special prizes or offers and are clearly associated with the Reader Offer.
Unless you tell us not to, Future Publishing Australia may give your information
to other organisations that may use it to inform you of other products, services
or events. If you would like to gain access to the information Future Publishing
Australia holds about you, please contact us.



Future plc is a public
company quoted on the
London Stock Exchange
(symbol: FUTR)
www.futureplc.com

Chief executive: Zillah Byng-Thorne
Non-executive chairman: Peter Allen
Chief financial officer: Penny Ladkin-Brand

Tel +44 (0)1225 442 244

INTEL®

PERFORMANCE

MAXIMIZER

Test Complete

Congratulations! Intel® Performance Maximizer has finished testing your system.

Frequency Before Testing:	4.70 GHz
Frequency After Testing:	5.00 GHz

Increase in Processor Clock Frequency: 300 MHz

TO THE MAX

A new golden age has begun.



There's no doubt AMD's absolutely killing it with the new Ryzen 3rd-gen. Perhaps their arrival has prompted you to consider an upgrade? If my small group of friends is any kind of useful barometer

then it would seem that almost everyone is jumping on the new Ryzens. More reliable statistical evidence is easy to come by. A quick look at the top selling CPUs on Amazon shows AMD with six of the top 10 – and that includes five of the top six and the number one spot (the 8-core, 16-thread Ryzen 7 3700X).

We have our first Ryzen 3rd-gen reviews in this issue, and do please come back next month as we continue to test all of the CPUs in this astonishing release.

With the new Ryzens comes a new motherboard chipset. The X570 brings truly generational leaps to the PC with stunningly quick PCIe 4 supporting new SSDs that take full advantage. We've gathered up a selection of X570 boards this month so you have the full picture if you're thinking of a new build.

To cap it off we've done one of our rare memory group tests, along with a buyer's guide, so you know what to look for there.

It's a particularly potent issue of APC this month, with so much jammed in covering this incredible time in the PC universe. I'm not sure

when we'll see another focused moment of upheaval of this magnitude. Relish it!

Elsewhere, in the Blue Corner, I've been testing the new Intel Performance Maximizer that I raved about in our Computex coverage in APC 470. As we reported, it's an internally developed automatic overclocking tool. At the moment it works with 9th-gen K-series CPUs in Z390 motherboards. Testing an i9-9900K in an Asrock Z390 Taichi yielded a 300MHz gain, taking the i9-9900K from 4.7GHz to a nice round 5GHz. That's decent enough, and comes close to the 5.1GHz manual OC this particular CPU is capable of. Future versions will support a wider range of motherboards and CPUs, but most interestingly will enable per-core overclocking. It's a free download and worth checking out if you have a compatible system and can't be fussed doing a manual OC.

Remarkably, Intel is also offering overclocking insurance – so that in itself is a surprising move. The Performance Tuning Plan costs US\$19.99 and adds coverage for overclock damage to the remaining term of your existing warranty. Never thought I'd live to see the day... See you in a month.

BEN MANSILL

EDITOR

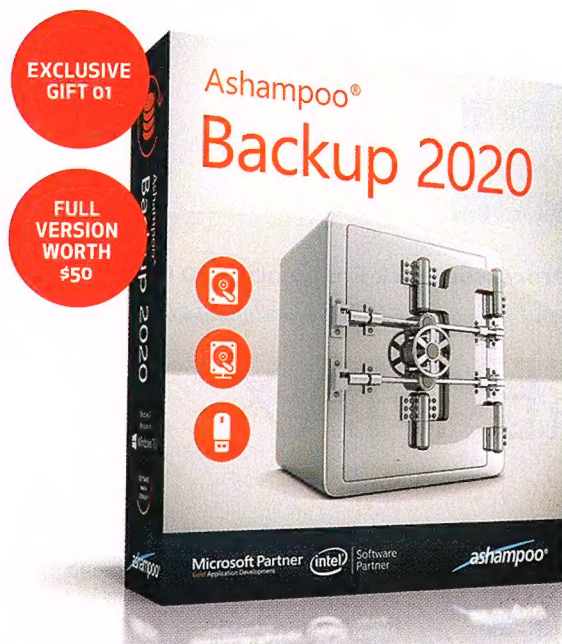
ben.mansill@futurenet.com

exclusive software

» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

ISSUE 471, SEPTEMBER 2019

Please note that these exclusive downloads will only be available for a limited time, from **12/08/2019 to 29/09/2019**



EXCLUSIVE
GIFT 01

FULL
VERSION
WORTH
\$50



EXCLUSIVE
GIFT 02

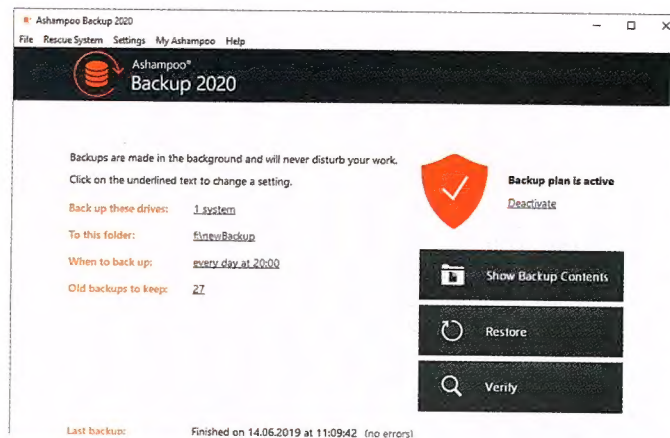
FULL
VERSION
WORTH
\$50

A NEW, IMPROVED BACKUP SUITE NEVER LOSE A FILE AGAIN WITH ASHAMPOO BACKUP 2020

FULL VERSION WORTH \$50

If you've ever stared at a black screen because your Windows refused to boot, you'll appreciate the value of regular backups. And it can be so easy! Only backups will protect you against impending data loss, as caused by ransomware, corrupt operating system or disks. Ashampoo Backup 2020 is the fool-proof backup software to save your files. The program backs up and restores entire partitions and disks in just a few clicks. Benefit from automated backups and fuss-free file recovery through the built-in rescue system!

Download link: www.ashampoo.com/lpa/apcmagazine



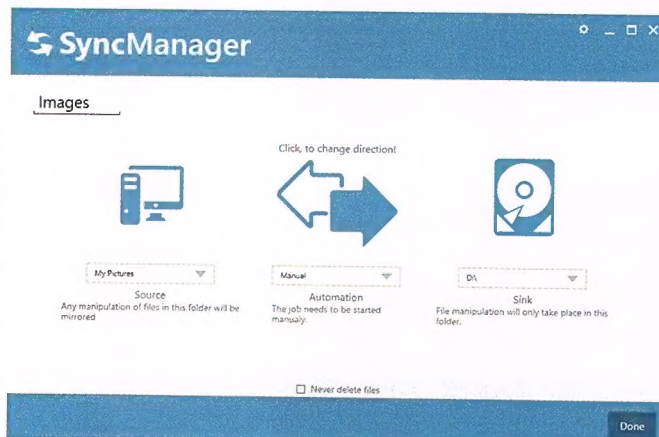
YOUR NEW FILE BUTLER HAS ARRIVED ENSURE FILES ARE WHERE THEY BELONG WITH ABELSSTOFT SYNCMANAGER

FULL VERSION WORTH \$50

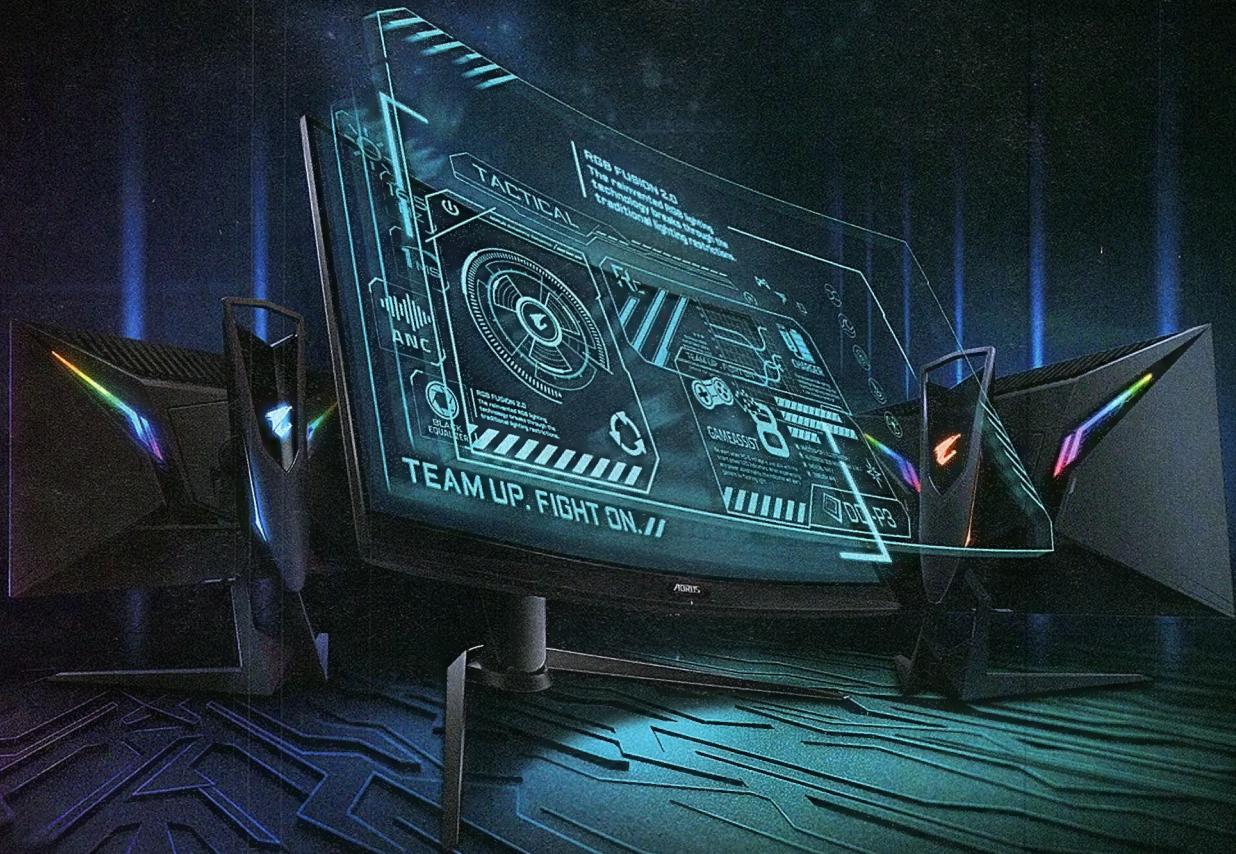
Not only practical, but also time-saving: Abelssoft SyncManager synchronises data in the background between folders, hard drives or other established devices. You can automatically copy your latest camera images to the desired archive, or perform an automatic weekly backup of your sensitive data to a connected external hard drive. No matter what you choose, the SyncManager takes care of the job.

DOWNLOAD: www.apcmag.com/exclusives

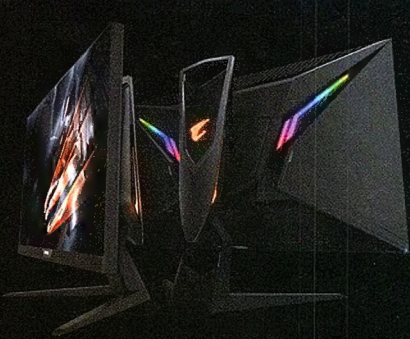
PASSWORD: July19g (note this is case-sensitive)



DISCLAIMER Future Publishing is not the licensor of the exclusive software or any documentation included with it. Rather, Future is merely a distributor of the software, and your use of the software is subject to any accompanying third-party licence terms. You must carefully read and comply with any such third-party licence terms, together with all instructions and README files that come with the software. Accordingly, to the maximum extent permitted by law, all software is provided by Future 'as is' and without warranty, either express or implied, and Future will not be liable for any damage that you may incur as a result of using any software downloads. You should back up any important system and data files before using any downloaded software. We recommend that you do not use the exclusive software on a production machine. Nothing in this disclaimer excludes any warranty that may be implied by statute, which may include the Trade Practices Act. While we have taken all reasonable steps to check the software downloads for viruses, we cannot guarantee that it is free from viruses or other harmful code and you should check each download using a virus scanner complete with the latest antivirus updates before use.



WORLD'S 1ST TACTICAL GAMING MONITOR SERIES



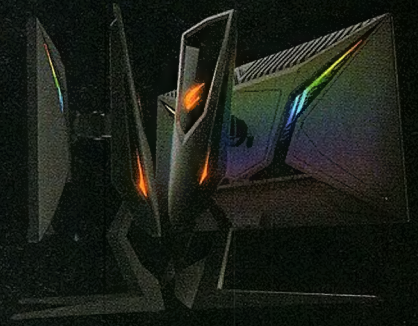
AORUS AD27QD [Flat Monitor]

Recommended for MOBA/
MMORPG GAME



AORUS CV27F [Curve Monitor]

Recommended for IMMERSIVE
ENTERTAINMENT



AORUS KD25F [Flat Monitor]

Recommended for FPS GAME



ACTIVE NOISE CANCELLING (ANC) AORUS UNIQUE IC DESIGN

Cancels out the environmental noises with
the least voice distortion



AIM STABILIZER GIVES YOU A STABLE AIM

Counter the motion blur and enhance
visual clarity



<https://au.aorus.com/>

GIGABYTE

Contents

44

AMD
RYZEN

SUPERCHARGED!

AMD RYZEN 7 3700X &
RYZEN 9 3900X



NEW AMD RYZEN

THE ONE WE'VE BEEN WAITING FOR
> IS INTEL #2 NOW?



AMD X570 MOTHERBOARDS

> NEXT-GEN PLATFORM
> SUPERFAST SSDS



MEMORY BUYER'S GUIDE

> FIND YOUR PC'S SWEET SPOT
> 8 KITS TESTED

63

60 OFFICE TIPS

GET MORE OUT OF MICROSOFT OFFICE AND LIBREOFFICE WITH EXPERT HELP FROM NICK PEERS

■ features

44 AMD RYZEN 7 3700X & RYZEN 9 3900X

The real deal

47 AMD X570 MOTHERBOARDS

AMD means budget? No way! Chris Szewczyk says hello to perhaps the most feature-packed desktop motherboards ever

56 MEMORY BUYER'S GUIDE

Chris Szewczyk takes a look at a range of DDR4-3200 memory kits and breaks down the things to look out for when shopping for a new kit

72 MOD MASTER PRO PC

How Australia's top PC modder Stuart Tonks built a stunning custom build for Western Digital and APC. AND YOU COULD WIN IT!

■ technotes

10 NEWS

The latest developments in the tech world

14 TECH BRIEF

Why you should consider moving to 5G

16 GADGETS

Hot tech gear we want to own

18 TWO BITS

Why on Earth is M.2 the dominant NVMe SSD interface?

19 END USER

The brave new world is eliminating ownership and history

20 HEAD TO HEAD

Best mid-range 1080p graphics cards: Nvidia GTX 1060 6GB vs. Nvidia GTX 1660 6GB vs. AMD RX 590 8GB

**WIN THE \$3,000
CUSTOM APC & WD
PRO-MOD PC!
SEE PAGE 72**



WIN!



24 LENOVO YOGA C930



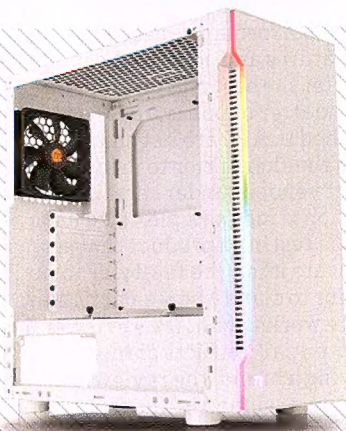
31 OPPO RENO 5G PHONE



29 NETGEAR NIGHTHAWK X6
TRI-BAND WIFI MESH



26 SEAGATE 510 NVME SSD



29 TT H200 CASE

the lab

LATEST REVIEWS

- 22** Razer Blade Pro 17 laptop
- 23** Gigabyte Aero 15 OLED laptop
- 24** Lenovo Yoga C930 laptop
- 27** Dell G7 gaming laptop
- 26** Seagate 510 NVMe SSD
Firecuda & Barracuda
- 28** Asus GT-AX11000
Gaming Router
- 29** Netgear Nighthawk X6
Tri-Band WiFi Mesh
- 29** TT H200 case
- 30** Asus T-AX92U Wi-Fi router
- 31** Oppo Reno 5G phone
- 32** Raspberry Pi 4
- 34** Oculus S VR

PC BUILDER

- 78** System News
- 79** Market Watch
- 80** Blueprint
- 84** PC Builder Masterclass

how to

QUICK TIPS

- 86** We fix your tech problems

TUTORIALS

- 90** Master Windows' Mail app
- 94** Make iOS behave better
- 96** Manage iCloud storage
- 98** Turning an old PC into a NAS

MASTERCLASSES

- 100** Retro Android
- 102** Using analogue HAT interfaces
- 104** Machine learning – with zero programming

downtime

108 GAMING NEWS

What's happening in the world of fun

110 GAMING REVIEWS

High-performance playtime

114 CHIP CHAT

Quirky news from the world of geekdom

technotes

» INSIDE APC

60 OFFICE & LIBRE HINTS AND TIPS

apc (Sep 2010 Issue #71)

WIN!

THE \$3,000 CUSTOM APC & WD PRO-MOD PC!

BEST 1080P GAMING CARD

AMD 5700 & XT VS. NVIDIA SUPER CARDS

AMD RYZEN

SUPERCHARGED!

THE HOTTEST REVIEWS OF THE YEAR

NEW AMD RYZEN

AMD X570 MOTHERBOARDS

MEMORY BUYER'S GUIDE

TURN AN OLD PC INTO A NAS

PACKED WITH REVIEWS

RASPBERRY PI 4

WATER BLADE PRO 17

OPPO RENO 5G

OCULUS RIFT S

GRABBYEAR OLED, LOGITECH G502

the lab » latest reviews



Asus ROG Rapture GT-AX11000 802.11ax Tri-Band Gaming Router

Huge in every way.

Despite the rather huge size of this, the Rapture shows you a picture of the game, lets you choose which platform you're playing it on and then promptly you to choose your device from a dropdown menu. The Game Radar section reveals on the Dash Board's main view where game servers in various countries are played for performance monitoring. There are plenty of other networking features. One is AiProtection which provides threat detection and network security plus parental controls. There are all kinds of network monitoring tools that are presented in a way that makes it easy to identify bandwidth hogs and roadblocks. They can also track which devices are visiting which websites which might be handy for concerned parents but gave us serious privacy concerns.

There are VPI terminations, USB file server features and every other network tool you might want. The Wi-Fi 6 performance blitzed our tests in that it managed to transmit our 115G cable internet connection two floors up without any need for extenders. It even did so with less than half the power of the 11000's predecessor (theoretical) potential throughput of 4.8Gbps (vs 3.5Gbps) married to an ultra-wide frequency band. In real-world tests it was hitting 1200Mbps transfers over 2.4Ghz which is around three times faster than predecessor technologies.

and 500Mbps in 5Ghz (which is about the same). However, if you have a super fast client technology (like Wi-Fi 6E) which supports 10Gbps transmission, you can reach 10Gbps wireless (upstream and downstream). Unless you've been counting the days for such peak wireless throughput, everything about this router is on track and not nearly worth the money. But that doesn't mean we're not impressed by the technology. **— Nick Ross**

Verdict

For feature-rich and fast, but how often will you be buying this? **★★★★★**



Dell G7 15



Oppo Reno 5G



Oculus Rift S

Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, APC's journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

BILLION[®]

PERFECT CHOICE, GENUINE VALUE

BiPAC 4700ZU

CAT.6

4G LTE Outdoor IP67 Rugged VPN Router

Supports the latest generation of LTE fixed wireless networks providing connectivity for homes, businesses, rural and under-served areas.



Dustproof &
Waterproof



L2TP/PPTP
IPSec/GRE



Wide temp
-40°C~65°C



**First International
Trading Pty Ltd.**

First International Trading Pty Ltd
Unit 35, 7-9 Percy Street Auburn NSW 2144
Phone: (02) 8318 3777

sales@billion.com.au
sales@firstint.com.au

technotes

» SHARMISHTA SARKAR & BEN MANSILL BRING YOU THE NEED-TO-KNOW TECH NEWS



Teslas will get a lot more expensive when full self-driving goes mainstream

MUSK SAYS HIS COMPANY'S CARS ARE AN INVESTMENT.

Tesla cars will become a lot more expensive when fully self-driving models are available, says the company's CEO Elon Musk. When responding to a tweet questioning whether customers had a limited time to snap one up, Musk stated that the "price will rise significantly" due to the expected autonomous capabilities and the value add that this provides.

Leading forensics firm reportedly pays ransomware demand

EUROFINS SCIENTIFIC WON'T CLARIFY WHETHER IT HAS PAID OR NOT THOUGH.

Eurofins Scientific, the leading forensic services outfit in the UK, has paid out to criminals who hit the company with a ransomware attack, according to a report. The attack occurred in early June, with the company stating that its operations would be returning to normal almost a month later, although it refused to state why it was able to do so.

Sony is reportedly working on a new smartphone that rolls right up

ROLLING TAKES ON FOLDING.

As folding phones begin to slowly trickle out to the consumer market, a rumour has arisen that Sony is working on a prototype of a rolling phone. The handset will apparently sport a Snapdragon 855 with 5G connectivity. While it is only a rumour, it joins similar talk of Samsung and LG aiming for the same form factor, the latter of which already has an OLED TV on the market that rolls up.



Study reveals ISP-supplied broadband modems are under-performing

TESTS PROVE WORST OFFENDERS BARELY COPE WITH 50MBPS.

A study commissioned by the Australian Communications and Media Authority (ACMA) has revealed that several ISP-supplied modems are incapable of handling 100Mbps speeds on a fibre-to-the-node/building (FTTN/FTTB) connection. The study has also found that several of these modems have poor Wi-Fi performance, further lowering the average download speeds the end user can expect. 43 modems from 11 manufacturers and 10 ISPs were tested in laboratory conditions during December and January and not one was able to deliver 100Mbps download speeds over a 450m copper stretch (the average length of copper on an FTTN connection). Most devices could only deliver 80% of the advertised speed.

In terms of Wi-Fi performance, 30% of the modems were unable to achieve 100Mbps on 2.4GHz over a range of 5m, which is unexpected as 2.4GHz is touted as the better option for long-range communication. Instead, tests showed that 5GHz Wi-Fi outperformed 2.4GHz. With walls coming in the way of Wi-Fi signals, the study found that 26% of the modems tested could achieve 10Mbps download speeds on the 2.4GHz Wi-Fi band, while 40% hit 80Mbps when using 5GHz Wi-Fi.

Australian ISPs want stronger laws on blocking malicious online content

ASKS GOVERNMENT TO CLARIFY MURKY LAWS.

A taskforce made up of tech companies like Facebook, Microsoft, Google and Amazon, alongside Australian ISPs, has proposed specific laws be put in place giving the country's eSafety Commissioner more power to block sites sharing malicious and abhorrent violent content online. This proposal comes in the wake of the Christchurch shootings in March when ISPs began proactively blocking websites hosting the video or sharing the shooter's manifesto. They relied on a vague subsection of the 1997 Telecommunications Act which gives the eSafety Commissioner the power to issue written directives to ISPs.

Now, however, the taskforce wants more concrete legislation, asking the government to develop a "protocol [that] would set out the arrangements and process for implementing blocks of websites hosting offending content, including the means of determining which ISPs would be subject to blocking orders, the length of time that the ISPs will be required to implement the blocks, and the process for removing the blocks".



msi

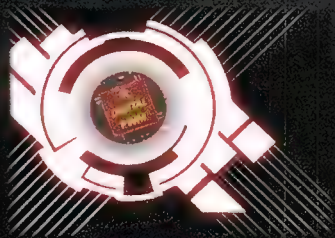
RYZEN AMD



THE NEW X570 MOTHERBOARD

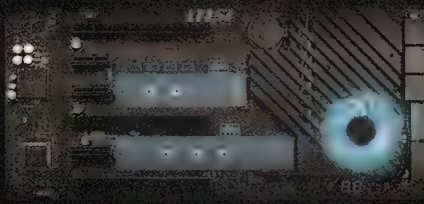
A NEW GENERATION ASCENDED

FOR CREATORS. FOR GAMERS.



CORE BOOST

MSI X570 whole series motherboards adopt high-end IR digital power design which provide faster and undistorted current delivery to the CPU at pin-point precision. Core Boost not only supports multi-core CPUs but also creates the perfect conditions for your CPU overclocking.



FROZR HEATSINK DESIGN

Designed with the patented fan and double ball bearings, Frozr Heatsink Design is not only to maintain the best performance for enthusiast gamers and prosumers, but also to provide the extra airflow for your M.2 SSD.

LIGHTNING GEN 4



LIGHTNING GEN 4 SOLUTION

Combining 3rd Gen Ryzen processors, MSI X570 motherboards feature latest Lightning Gen 4 solution on both PCI-E and M.2 slot. FOR MEG series motherboards, you can even find triple Lightning Gen 4 M.2 slot with up to 64Gb/s speed.

See the all-new range at au.msi.com



Now you can see why you're targeted by Facebook ads

INCREASED TRANSPARENCY FOLLOWS CAMBRIDGE ANALYTICA LEAK.

In March this year, Facebook released a tool called "Why am I seeing this?", which allowed users to take a deeper look at the ads they were being shown and the reason they were being targeted. The service was created in response to the public outcry following events like the Cambridge Analytica scandal, which raised concerns about the abuse of user data by giant tech companies and the lack of privacy that it entails.

Today, Facebook has announced that it's further improved the tool, claiming to have increased the amount of transparency offered overall. This includes much more intricate detail on the reason for being targeted, a clearer list of the companies that own and sell your data, and a direct link to a page where you can change your targeting preferences, including the ability to opt out entirely in certain instances.

In order to view which marketing companies and data brokers have your information and are selling it to advertisers, head to Settings > Ads > Advertisers and Businesses > "Who has uploaded and shared a list with your info".

Nvidia quietly patches Tegra exploit

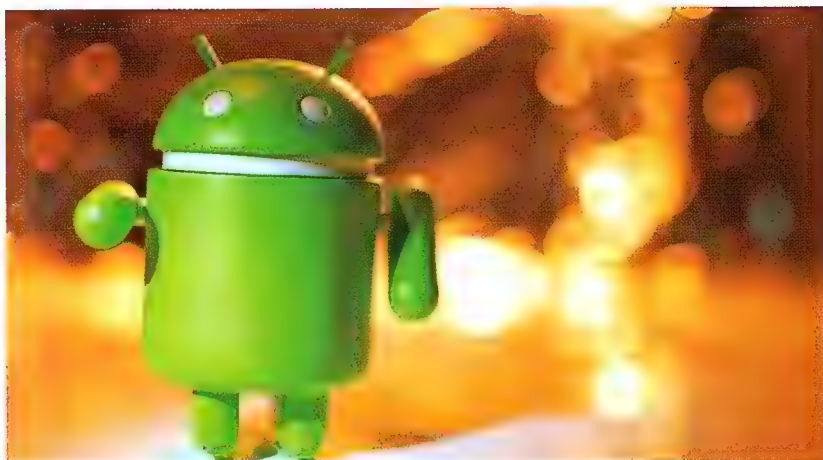
REMAINS CAGEY ON EXACT DETAILS OF VULNERABILITY.

Nvidia released a security update for the Jetson TX1 in the Tegra Linux Driver Package (L4T) on July 18. The associated security bulletin offered precious few details about what Nvidia fixed, but on GitHub, a researcher named Triszka Balázs revealed that the company was patching a flaw that enabled malicious code execution on "every single Tegra device released so far" via what he called the Selfblow exploit.

Microsoft plans Windows Defender rebrand

EXPANDING TO COVER MORE PLATFORMS.

Windows Defender and most of its associated services will be rebranded to Microsoft Defender when Windows 10 20H1 is released early next year, according to *gHacks*. The theory is that Microsoft wants to change Windows Defender's name so it's no longer associated solely with Windows. This would allow Defender to be expanded to Android, iOS and Linux, say *gHacks*.



Over 1,300 Android apps scrape personal data regardless of permissions

FIXES COMING WITH ANDROID Q STARTING IN AUGUST.

Smartphone operating systems have ramped up their privacy settings in recent years to let users pick and choose what information apps can get, but it seems those permissions aren't ironclad. A new study revealed that over 1,300 Android apps can scrape certain personal data anyway, even if a user explicitly denied access to it. Researchers at the International Computer Science Institute (ICSI) created a controlled environment to test 88,000 apps downloaded from the US Google Play Store. They peeked at what data the apps were sending back, compared it to what users were permitting, and found that 1,325 of them were forking over specific user data they shouldn't have. Among the test pool were "popular apps from all categories," according to ICSI's report. The researchers disclosed their findings to both the FTC and Google (receiving a bug bounty for their efforts), though the latter stated a fix would only be coming in the full release of Android Q.

Huawei CEO claims firm's own mobile OS will be faster than iOS and Android

BUT APPS COULD BE A STICKING POINT.

Huawei CEO, Ren Zhengfei, has said that the company's home-grown mobile operating system (OS) will be faster than both iOS and Android... but it could struggle when it comes to apps. Zhengfei made the claim during an interview with French magazine *Le Point*, and the Huawei chief remains bullish about his company's chances in the market, no matter the long-term outcome of the current US-China trade war. It's no secret that Huawei is working on its own OS, which it could employ on smartphones if the US follows through with its Huawei ban, a ban which would see the Chinese manufacturer lose access to Google's vital Android services such as the Play Store, security updates and suite of Google apps. While Huawei's HongMeng OS (also known as Ark OS) may run faster than the software found on rival devices, Zhengfei admitted that it may struggle when it comes to apps. In the past few years we've witnessed Windows Phone and BlackBerry OS try, and fail. ■



BLANK CANVAS,
UNLIMITED POSSIBILITIES



H200 BLACK & SNOW
RGB TEMPERED GLASS CASE

tech**brief**

» A DEEPER LOOK WHAT'S TRENDING IN TECH.

Why you should consider moving to 5G

There are some advantages to getting in on 5G early.

All the buzz around 5G makes it seem like the next must-have technology. However, because it requires a new phone and a top-tier unlimited plan, it can be hard to know when it makes sense to make the jump to 5G. While 5G still isn't ready for everyone, there are some people that will benefit from everything on offer. 5G is in its early stages, but there are still some advantages to getting in on it now.



You live in a covered city
So take advantage.

This is the biggest "if" when it comes to 5G. If you live in an area that currently has or will very soon have 5G coverage then you will be all set to receive every benefit. While connected to 5G, data will be faster and more responsive than the current 4G tech and more consistent than hopping from one free Wi-Fi point to another.

"Treating data like a limited resource can really hurt"

Move to the cloud

Get that data flowing.

A lot of us know the benefits of cloud saving – save space on your phone and reduce clutter by offloading apps and saved files to the cloud. 5G can help you retrieve these files with little delay and can allow you to work from multiple devices fluidly. It can also simply reduce load on your local machine.

Treating data like a limited resource can really hurt the usefulness of a phone. When data is an afterthought, you are free to use your phone to the best of its ability without worrying about your connection. New phones have beautiful, high resolution displays and having the data needed to push full HD and 4K videos with 5G finally takes advantage of these beautiful screens.

Make your new device relevant longer

Use all of the power.

Many people commit to a couple years before upgrading their smartphone. With 5G deployment right around the corner for most people, having a phone that will be ready for this new technology makes sense. With a 4G-only phone, you could be paying for a network you can't even access until your next upgrade opportunity.

Buying electronics for next year rather than this year is a common practice for many people. It's annoying having a phone that doesn't support the newest tech when it's only a few months old. 5G phones available right now, like the Galaxy S10 5G or LG V50 ThinQ 5G are some of the fastest and most complete Android phones available. If you get a 5G phone today even without 5G service, the great hardware inside like the powerful Qualcomm X50 modem will get you the best of 4G LTE until 5G comes online.

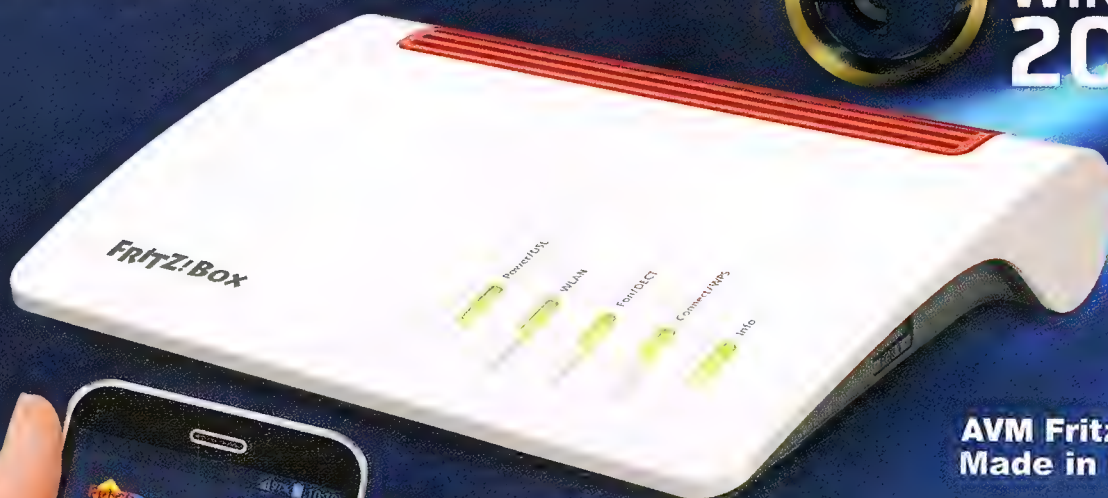
If you are connected to 5G technology you are connected with the most modern, most powerful wireless network available. With 4G LTE Advanced, you can get many of the speed benefits of 5G, but your latency will be higher and you won't have access to newer technology like edge computing when it comes into effect. This latency will be felt when navigating many different apps that require a constant online connection. The extra milliseconds it takes 4G LTE to form a connection can really start to add up for a heavy user.



Quality entertainment around the clock
Enjoy great entertainment throughout the entire home network.
Keep everything as simple as possible.



**GERMAN
DESIGN
AWARD
WINNER
2018**



AVM Fritz!Box 759
Made in Germany



**Encrypted communication
via VPN**



**At home anywhere with
MyFRITZ!**



**Answering machine with
voice to mail**



**Ready for the future with
IPv6**



**FRITZ!Apps for iOS
and Android**



**Smart WiFi technology
Multi-User MIMO**



**Two wireless networks
for more flexibility**



**Band steering:
smart band selection
convenience**



**Mesh WiFi with FRITZ!
enjoy full mesh networking**



**Connected in no time
with WPS (Wi-Fi Protect-
ed Setup)**

gadgets

» JOEL BURGESS GATHERS THE GOOD GEAR

SMACH Z

Portable PC Gaming: the perfect Smach.

FROM \$999 | WWW.SMACHZ.COM

The Smach Z is a Switch-like handheld console that claims to be powerful enough to play any game you can buy from the major PC game stores. While its initial crowdfunding campaign was way back in 2016 the Smach Z is now finally ready to launch. Whether it's *Dark Souls 3* or the *Witcher 3*, the team behind this Kickstarter reckon the Smach's AMD Ryzen Embedded V1000 chip is powerful enough to run them at 40+fps on medium 720p settings. In fact the company claims it can play any game available in the major PC game stores. Not a bad proposition for gaming on-the-go.



SONY WF-1000XM3

Sony's latest true-wireless buds take on the sound around you.

\$399 | WWW.SONY.COM.AU



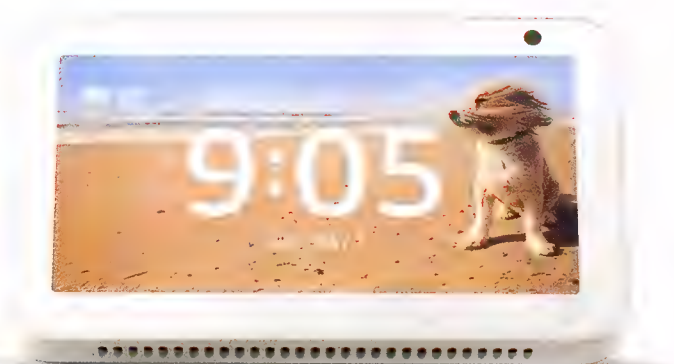
Sony's current active noise cancelling over-ear headphones are some of the best around and its decided to bring that tech across to a new pair of true-wireless 'buds. The WF-1000xM3s are powered by a new noise cancelling QN1e processor that combines input from independent noise sensors in each headphone to minimise unwanted ambient sound. The headset also seems to be taking a different approach to connectivity, directly pairing each bud to your phone in order to minimise connection dropouts. 24-bit HD audio signal processing, a six hour battery life (24 hours including case), fast charging and Google Assistant optimisation add up to a lot of features for such a compact package.

AMAZON ECHO SHOW 5

Amazon's latest show and tell smart speaker.

\$129 | AMAZON.COM.AU

If you liked the idea of an Echo Show, but felt it was a little too big or that it could cost a little less, then you'll be pleased to hear that the new Echo Show 5 has a more compact 5.5-inch screen and costs just \$129. Not only is that a good deal less expensive than the Echo Spot, but it's also pretty close to a 16:9 aspect ratio, which makes it way better for video calling. While the display is useful for getting visual responses to questions, changing settings, watching videos or using it as a doorbell intercom point, one of the best perks is the Skype or Drop-In video calls.





GRAVASTAR BLUETOOTH SPEAKER

Desktop cyborg speakers are here to claim your desk space.

US\$249 | WWW.ZOEAO.COM

OK, so we might be judging a book by its cover with this one, but when the cover is an orb with neon green cyborg legs, it's hard not to. The GravaStar Bluetooth Speaker is a crazy looking desktop speaker, designed to sit either side of your monitor. The speakers are clad in a zinc alloy shell that's lit by an array of green LED lights that make it look like there could be a small AI invasion taking place on your desk. The high quality materials seem to extend to the 70mm 20W full-range driver and 80mm rear passive radiator which can be connected in stereo via a Bluetooth 5.0 connection.

RING STICK-UP CAMERA

This is a different kind of stick-up.

\$319 | AU-EN.RING.COM

The Amazon-owned security company Ring has a new indoor/ outdoor camera to keep an eye on your home or business. This FullHD security camera can be powered by its own solar panel, hardwired in or run off rechargeable batteries, giving a much greater overall placement versatility. The camera connects up to your home Wi-Fi network, allowing you to see a live feed from anywhere and you can automatically save motion detected video to the cloud with a Protect plan starting at \$4 per month. The camera includes a two-way speaker and microphone array, allowing you to interact with people on the other end at any point.



GPD P2 MAX

A laptop that fits in your pocket.

US\$840 | WWW.GPD.HK/GPDP2MAX

We're often skeptical about the claims made by crowdfunded projects, but an 8.9-inch ultrabook that weighs 650 grams is undeniably the smallest ultrabook we've heard of. This tiny laptop features a 2560x1600 touch screen, Intel Core m3-8100Y CPU, 16GB RAM and 512GB SSD, which means the only thing this device cuts down on is size. The P2 Max runs full Windows 10 Home and there's even a water cooling array to keep that processor operating at full-tilt. The keyboard and trackpad look usable and there's a surprising number of interface options, so we can't think of a reason why this device wouldn't be awesome. ■

Why on Earth is M.2 the dominant NVMe SSD interface?

Chris Szewczyk explains why M.2 SSDs need to go the way of the Dodo.

It came to a climax when benchmarking X570 motherboards. M.2 SSDs are just horrible. There I was, removing tiny screws, pulling off a heatsink half the size of the motherboard, dropping said tiny screws just a little too often, all to connect one SSD. Surely there has to be a better way? And there is! It's called U.2.

Let me just state that there's nothing wrong with the M.2 interface itself. It's perfectly suited for a lot of devices. Wi-Fi? Bluetooth? Those kinds of devices are compact, use little power and are perfect for adding functionality in constrained spaces where a PCIe add-in card isn't feasible. The problem is that the M.2 form factor, specifically the 2280 sized one that's easily the most prevalent, just isn't suited to huge throughput, high end enthusiast SSDs.

Modern NVMe drives run hot. So hot that they can and do throttle to protect themselves. Do you really want your critical data subjected to that? Consider that modern enthusiast systems equipped with AIO water cooling lack airflow across the board. Then there's the positioning of many M.2 slots directly adjacent to a hot GPU. It's not exactly conducive to having a cool running, long life SSD. This will only be exacerbated by PCIe 4.0 drives. The Aorus PCIe 4.0 drive we used for testing with X570 has a hefty, all enclosing copper heat sink. Why equip it with that if it doesn't need it?

Witness the lengths drive and motherboard manufacturers are going to keep SSDs cool. Either drives are coming with pre-attached heatsinks or motherboard makers are resorting to covering half the board with a gigantic cooling apparatus. As we see with X570 motherboards elsewhere in this issue, chipset fans have made a return. Depending on the board, they aren't

"Chipset fans have made a return. Depending on the board, they aren't necessarily just there to keep the chipset cool, they're there to keep hot NVMe drives cool too."

The U.2 connector, may it conquer the M.2 for our sanity.

necessarily just there to keep the chipset cool, they're there to keep hot NVMe drives cool too.

A few years ago, high end boards came with a U.2 connector but now sadly, it's relegated almost exclusively to the professional market. Essentially it offers the same functionality as M.2, but connects via a cable instead.

U.2 drives have so many advantages. You can keep them isolated from other hot components, cool them easier and prevent them from throttling, leading to a longer life and hence keep your data safer. Manufacturers won't be constrained by the 80mm wide PCB and therefore offer larger capacities, improved heat dissipation properties and free up motherboard real estate. A

2.5-inch U.2 drive can be inserted into any case that has 2.5-inch support (as in, all of them).

For some reason, somebody (who?) decided that attaching an SSD directly to the motherboard was a good idea. Is it the aversion to having a visible inch of cable coming from a port? Are aesthetics so important that they outweigh every other concern? Why not just make an RGB U.2 cable? Problem solved!

So, big Multinational Corporation, can I have U.2 drives please? They won't throttle, they're cooler and more convenient. I can stash them out of sight and I'd feel safer about my data's integrity. Please? Pretty please? ■

Forever yours?

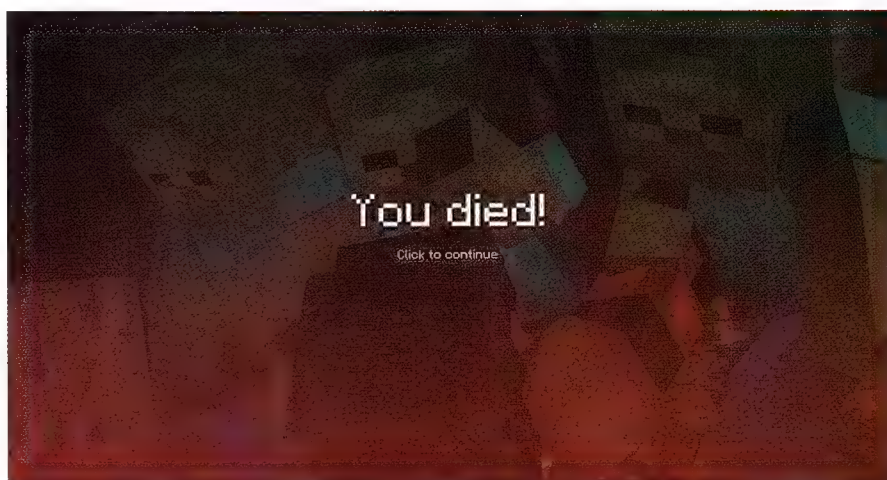
The brave new digital age is eliminating ownership and history, writes Shaun Prescott.

Conversations around digital goods, and whether consumers “own” the digital products they purchase or not, have been raging for years. But in 2019 they’re especially pertinent, with the growing encroachment of cloud-everything occurring alongside the steady decline of physical distribution.

There are few areas where this shift is felt more than in video games. When Telltale Games shut down in 2018 a big question mark hovered over the future of their serialised, narrative driven games, in particular *The Walking Dead*, *Minecraft Story Mode* and *Tales of the Borderlands* (among others). The fate of each has varied. For example, *The Walking Dead* was wrapped up by Skybound Games, rather than Telltale, and is still available to purchase digitally. By contrast, *Minecraft Story Mode* has had a curious and alarming fate. *Minecraft* studio Mojang announced in June that the game was soon to be delisted from all digital storefronts, which isn’t that rare. What is rare, is that users who “owned” the game on any storefront were warned to download the game before the June 25 deadline, because it would no longer be available to download afterwards.

Traditionally, consumers who own the digital licenses to video games have continued to have access to that game, whether it’s available for purchase or not. See: *Deadpool*, *Transformers: Devastation*, and a slew of others. But the game consumers purchased with real money only four years ago is gone forever, unless they have it installed on one of their devices.

This is cause for extreme concern for anyone under the impression that they’ll forever have access to the digital products they purchase. But it’s also a problem for the preservation of



the medium. It’s feasible that in ten years basically no one will have access to *Story Mode*, and for people who consider games to be an art form rather than a consumer commodity designed to be chewed and spat back out by an insatiable market, that’s a terrible thought.

But technology is veering inevitably in that direction. Google Stadia is a case in point: it’s a cloud streaming service for video games, and yet, unlike Netflix or Xbox Game Pass, users will purchase games individually for it. In other words, it will function like every other games console, only the digital assets you’re “purchasing” are not stored locally. Putting aside qualms about whether Stadia will even work in Australia given our gimped infrastructure, this means your games library will only survive for as long as Stadia does.

When asked during a recent Reddit AMA what would happen if Stadia “went under”, Google’s Andrey Doronichev wrote that the company is “super committed”.

“We have hundreds of passionate

people who have spent years building it,” he wrote. “We’ve invested a ton in tech, infrastructure and content.” And there’s no doubt they have. But no one can be certain that it will last forever – that’s just a quiet existential truth and hardly Google’s fault, as fun as it would be to blame them. As it stands, if you purchase a game on Steam and download it to your device, you’ll still be able to access it (maybe with some fiddling) if and when Valve goes under. But when the cloud goes, everything does.

There’s no telling how successful Stadia will be or whether it lasts, just as there’s no telling whether any game you digitally “own” will suddenly become unavailable. And physical media, in the games space, is pretty much obsolete thanks to always-online requirements and substantial day one updates. Increasingly, the likelihood of games surviving the rise and fall of platforms seems ever more remote. If you’ve got any interest in preserving a library of games, your only real option is to vote with your wallet and hope for the best. ■

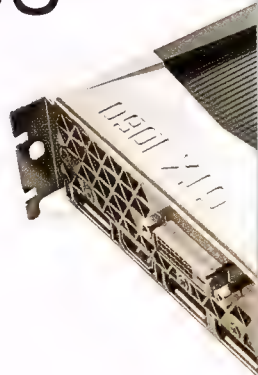
END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer’s full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

GTX 1060 6GB vs. GTX 1660 6GB vs. RX 590 8GB

Battle for the best 1080 gaming card.



There's plenty to choose from right now in the world of gaming GPUs. With Nvidia recently releasing the GeForce GTX 1660 series, choosing a card for 1080p gaming is a challenge. So, we have nailed down the three best 1080p cards currently available – the new GTX 1660 6GB, the older GTX 1060 6GB, and AMD's Radeon RX 590 8GB – and we're going to break down their pros and cons.

Round 1

VALUE

At a first cursory glance, the GeForce GTX 1060 is the victor here. It's the cheapest card of the three, after all, costing \$370 on average, although the Radeon RX 590, at around \$390, is extremely close. Looking at price-per-gigabyte, the RX 590 beats out both the other cards, packing 8GB of GDDR5 memory against the 6GB offered by the other pair. That extra graphical memory puts the Radeon card in good stead, too – despite being older, the 590 can hold its own, with performance on par with the GTX 1660, even at 1440p ultra settings.

The GTX 1660 might be the newest of the three GPUs here, but prices have dropped quickly – you should be able to snap one up for only a little more than the GTX 1060, with \$380 the going price at the time of writing. As you might expect, the GTX 1660 is great value when it comes to baseline performance, although the memory speed isn't any faster than that of the RX 590. Given the minimal price variation, our recommendation for value has to go to the RX 590. The GTX 1060 is too old to justify its price point, while the 590 is a solid card that slightly undercuts the 1660 on cost.

WINNER:
RX 590

Round 2

EFFICIENCY

Sorry AMD, but Radeon isn't winning this one. The RX 590 is a good card, but it demands 175W of power without overclocking; almost a third more than the 120W required by each GTX card. The system power draw if you attempt to properly overclock is nightmarish, too, the GPU demanding as much as half of the build's entire power budget. Swapping from Nvidia to AMD can often force a PSU upgrade. It's not particularly quiet, either, though this depends on the specific model you purchase. It's worth noting that if you choose to cool your GPU with liquid, noise ceases to be a factor, of course.

The GTX 1660 feels like a clear winner in the efficiency stakes, though. In terms of what it demands from your system, it's near-identical to the 1060, but it simply pumps out superior performance, typically running at around 10–12 percent faster than the 1060, without any significant increase in noise or running temperature. Certain versions of the card perform more efficiently and quietly, too, thanks to manufacturers' proprietary fan technology. That's not to say the GTX 1060 is a slouch in this department, though; most models run very quietly and draw a sensible amount of power – it simply can't quite keep up with its newer descendant.

WINNER:
GTX 1660

Round 3

OVERCLOCKING

Looking purely at factory boost clocks, the GTX 1660 powers through here. With a boost clock of 1,785MHz against a 1,530MHz base clock, it boasts both the highest maximum speed and the greatest percentage increase from base to boost out of all three cards. The RX 590 struggles with overclocking; even when it was originally released, it ran on two-year-old architecture, so it won't hit any higher than 1,700MHz, even with some serious tweaking. This is perhaps unsurprising to those in the know – the RX 570 and 580 also struggle with overclocking, which results in high temperatures with minimal speed gains.

The 1060 can perform almost as well as the 1660, however, despite its age. It's relatively impressive, with a factory boost clock just barely over 1,700MHz. It still comfortably beats out the RX 590 – manual overclocking should easily throw at least another 100MHz on top, too.

When it comes to memory speed, the 590 performs better, capable of hitting 9GT/s (a similar figure to the 1660). The 1660 simply dominates when you commit to proper overclocking. If we dive under the hood, there's simply greater capacity to push the limits of the 1660's hardware. Maxing out fan speeds and heat limits let this card crack 2,000MHz – impressive, given that it still uses GDDR5.

WINNER:
GTX 1660



Round 4

LONGEVITY AND MAINTENANCE

On average, the GTX 1660 is the best card here, but only by a small margin. Unsurprisingly, the 1060 doesn't perform too well, but it does the job. Performance across our benchmark games is very varied. The RX 590 dominates in some games, but lags behind both GTX cards in others. This is primarily due to AMD or Nvidia preference from developers in game design, and shouldn't really be a factor when deciding on a card – unless you plan to only ever play one or two games.

The GTX 1060 lags behind in this department due to its age, although the RX 590 puts out reliable figures despite its two-year-old architecture. Broadly

speaking, in games where the 1600 boasts higher fps figures, the 590 only narrowly loses out. Both are capable of hitting 60fps at 1440p, too, if you're willing to lower the graphical settings.

Variation between average fps and minimum fps (in the 97th percentile) differs between the cards, too. The 1660 varies by 47 percent on average, while the 590 only varies by 39 percent, and the 1060 by 37 percent, making them both more stable than the 1660. This could be written off as driver maturity, however; the 1660 will likely perform within tighter parameters once it's been around for a while. Overall, we have to give it to the newer card.

	GTX 1660 6GB	GTX 1060 6GB	RX 590 8GB
TOM CLANCY'S THE DIVISION 2 (AVG/MIN FPS)	62/42	57/45	69/53
DEUX EX: MANKIND DIVIDED (AVG/MIN FPS)	55/43	47/37	56/45
FAR CRY 5 (AVG/MIN FPS)	82/62	71/60	80/70
GRAND THEFT AUTO 5 (AVG/MIN FPS)	64/40	57/42	50/37
MIDDLE EARTH: SHADOW OF WAR (AVG/MIN FPS)	61/41	52/36	58/37
METRO EXODUS (AVG/MIN FPS)	46/26	40/22	44/24
TOTAL WAR: WARHAMMER II (AVG/MIN FPS)	65/49	60/48	56/44

Our test bed consists of an Intel Core i7-7800K, 16GB of G.Skill DDR4-3200, a Gigabyte Z370 Aorus Gaming 7, and a 1TB Samsung 970 Evo M.2. All games are tested at their highest graphical profile with AA turned on at 1080p. Figures provided are an average and a minimum (97th percentile) respectively.

WINNER:
GTX 1660

And the winner is...

The numbers don't lie: Right now, the GeForce GTX 1660 rules the roost when it comes to 1080p gaming. Were it not for the price drops on Nvidia's cards, though, we'd really consider giving it to the RX 590. It's a solid all-rounder of a GPU, with a reasonable price point. If you want to go with Radeon right now, it's definitely the card we'd recommend for 1080p gaming. We can't really find it in our hearts to recommend the poor GTX 1060, though – it's a good unit, and if you're already rocking one, there's no real need to upgrade just yet, but it can't compete with the current generation of sub-\$400 cards.

The 1660 isn't a mind-blowing card by any means, but if you're looking for mid-range gaming that won't hurt your wallet, it's the best option right now. If you're using anything older than a 970, it's an excellent choice of upgrade. However, with the first Navi and Nvidia Super cards upon us, you may want to consider stretching your budget a little further and gaining more performance and future-proofing via those next-gen cards.

the lab

» LATEST REVIEWS



LAPTOP

\$4,799 | WWW2.RAZER.COM

Razer Blade Pro 17

Razer's big boy gaming laptop comes with a hefty price tag, but does it have the minerals to justify it?

The last Razer Blade Pro launched back in 2017 so this year's update is a big step forward. The new Blade Pro 17 jumps from a 7th generation Intel Core i7 CPU to a 9th generation i7-9750H, which boosts the computer's raw CPU performance by between 18 and 24%. This translates to a slightly more conservative improvement of between five and 18 percent in general home and work tasks, but it's still enough to justify the upgrade.

The GPU saw a similar generational jump with the predecessor's Nvidia GTX 1060 and 1080 GPUs being replaced by RTX 2060, 2070 or 2080 (Max-Q) cards. Since we tested the 2017 Blade Pro

17 with a GTX 1060 and the current model we tested with an RTX 2070, a direct comparison doesn't make much sense. The new GPU performed in line with what you'd expect from an RTX 2070 with game framerates of between 56 and 97fps on *Ghost Recon: Wildlands* and *Middle Earth: Shadow of War* respectively, using Ultra 1080p settings.

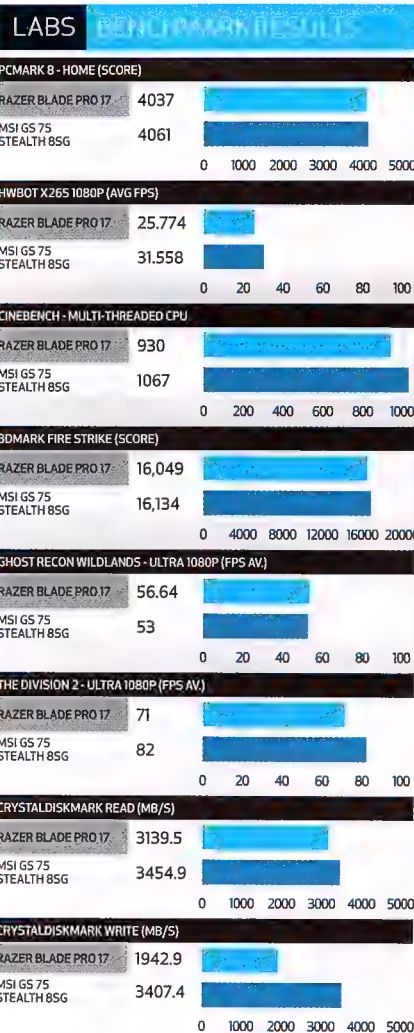
With most games averaging above 60fps on Ultra settings there's enough grunt on this model to justify the 144Hz 17.3-inch display, but only just.

Considering this, we wouldn't recommend getting the entry level GPU configuration, unless you only play less graphically intensive shooters or you're willing to dial down the

graphics presets for higher framerates.

Razer's last Blade Pro 17 ditched the number pad for a trackpad that lined up with the keyboard and while the new model is still repping a tenkeyless layout, it has returned the trackpad to the less controversial centre front position. While we prefer this layout, Razer don't seem to have expanded the keyboard size, so it is skirted by an abundance of plain metal chassis. The chunky speaker grills line up with the keyboard and provide a nice overall balance, but we can't help but feel like Razer could've utilised this space in a more functional and less minimalistic way. Battery life was also disappointing at just one hour and 52 minutes

"Since it's not powerful enough to fully utilise the fast screen we wouldn't recommend the entry level \$4,299 Blade Pro 17"



for PCMark 8's home battery benchmark and you'll probably only get a couple more hours from sparse usage.

Since it's not powerful enough to fully utilise the fast screen we wouldn't recommend the entry level \$4,299 Blade Pro 17, but the RTX 2070 and RTX 2080 models only come with 16GB of RAM and a 512GB SSD and cost \$500 or \$1,150 more respectively – so really all three are too expensive to recommend. You can get a Gigabyte Aero 17 XA with identical specs for \$1,050 less and we've seen MSI GS75 units with double the RAM, double the PCIe storage and an RTX 2080 going for a similar price.

■ Joel Burgess

Verdict

A premium specced gaming unit that is overpriced and a little short on high-end features.





LAPTOP

\$3,799 | GIGABYTE.COM/AU

Gigabyte Aero 15 XA OLED APC

OLED is the new black, but is this screen tech a good fit for ultraportable gaming laptops?

Gigabyte's Aero 15 XA is the first laptop we've seen to utilise an AMOLED screen and while our expectations were high, the 15.6-inch 4K display is somehow even better than we could have imagined. Whether you're in the depths of a Metro: Exodus tunnel or floating above the Total War: Warhammer 2 campaign table it's hard not to be impressed by the distinct vibrancy of this Xrite Pantone-certified colour calibrated AMOLED screen.

One of the coolest things about OLED for gaming is the extremely low (sub 1ms) latency. Unfortunately, the Aero 15 XA OLED display only runs at 60Hz, so anyone needing an ultrafast competitive screen will have to look elsewhere. While it would have been nice to see a faster panel, even if you get the Aero 15 YA with an RTX 2080 GPU,

you'd struggle to get more than 60fps on UHD Ultra settings, so there's no real need for high refresh 4K OLED on a laptop just yet.

The Aero 15 OLED we tested came with an Intel Core i7-9750H CPU (which can be upgraded to a Core i9-9980HK), 16GB of RAM and a Nvidia RTX 2070 GPU, for a total cost of around \$3,799. Adding the i9 processor will set you back an additional \$600, or alternatively you can keep the i7, double the RAM to 32GB and bump the GPU to an RTX 2080 for \$4,799 total. This definitely puts the Aero 15 at the pricey end of the spectrum, but if you're happy to pair back the gaming performance you can actually nab it for as little as \$2,999 when configured with a GTX 1660Ti.

Performance was as expected, with the updated 9th generation CPU offering minor performance

improvements on general working tasks against its predecessor. The Aero 15 XA OLED with a RTX 2070 GPU managed to get between 49 and 75 fps on Ghost Recon: Wildlands and Middle Earth: Shadow of War respectively, using 1080p Ultra settings. If you increase the resolution to 4K you generally see frame rates between 20 and 30 fps, allowing you to just play new titles if you tweak a few things. Fortunately the OLED display still looks excellent at FullHD resolution, so the lower specced models still get great colour benefits from the new display.

We've spoken a lot about other features, but the actual design of the Aero 15 has been entirely reworked too, featuring a new metal top-shell, reengineered keyboard surround and tweaked vent design. The keyboard keys feel nice and responsive, the trackpad is

smooth and there's a number pad, fingerprint reader and physical webcam shutter to appease the privacy conscious. Battery life was impressive managing four hours and 20 minutes in the demanding PCMark 8 battery benchmark, which means you should get close to a full working day from it.

The Aero series is just cm thick and weighs just 2kg, so it fits neatly within the ultraportable gaming laptop category. You can get gaming laptops with similar specs for up to \$700 less, but you'll have to sacrifice a little on portability and battery life, or settle for an 8th generation CPU. ■ Joel Burgess

LABS BENCHMARK RESULTS

PCMARK 8 - HOME (SCORE)

GIGABYTE AERO 15 XA OLED	3581	
GIGABYTE AERO 15 X9 (i7)	3324	

CINEBENCH - SINGLE CORE CPU

GIGABYTE AERO 15 XA OLED	184	
GIGABYTE AERO 15 X9 (i7)	159	

3DMARK FIRE STRIKE (SCORE)

GIGABYTE AERO 15 XA OLED	13,962	
GIGABYTE AERO 15 X9 (i7)	15,232	

GHOST RECON WILDLANDS - ULTRA 1080P (FPS AV.)

GIGABYTE AERO 15 XA OLED	49.28	
GIGABYTE AERO 15 X9 (i7)	51	

TOTAL WAR: WARHAMMER II - ULTRA 1080P (FPS AV.)

GIGABYTE AERO 15 XA OLED	65.7	
GIGABYTE AERO 15 X9 (i7)	68.5	

CRYSTALDISKMARK READ (MB/S)

GIGABYTE AERO 15 XA OLED	2548.3	
GIGABYTE AERO 15 X9 (i7)	2753	

CRYSTALDISKMARK RWRITE (MB/S)

GIGABYTE AERO 15 XA OLED	1515.1	
GIGABYTE AERO 15 X9 (i7)	1519.8	

PCMARK 8 - HOME BATTERY ACC. (HH:MM)

GIGABYTE AERO 15 XA OLED	04:20	
GIGABYTE AERO 15 X9 (i7)	02:50	

Verdict

A competitively priced offering with a uniquely vibrant screen, powerful components and a solid battery life.





LAPTOP

\$2,399.10 | [LENOVO.COM/AU/EN/](http://lenovo.com/au/en/)

Lenovo Yoga C930

Is Lenovo's latest convertible as flexible as ever, or have its new changes bent it out of shape?

The Lenovo's Yoga series has a premium pedigree to lean on, but in a space as competitive as the 2-in-1 convertible scene, you need more than just good quality components to stand out. The C930's headline feature is a new hinge design that manages to maintain smooth, fully-rotatable functionality, while incorporating a set of Dolby Atmos speakers. This novel hinge speaker design is perfectly positioned for general laptop audio, but it also manages to improve speaker positioning when in tent, picture frame or tablet modes.

The Yoga C930 doesn't just look business ready, it's also got a nicely weighted 10-keyless keyboard and a dedicated fingerprint scanner that offers enhanced productivity and security. The trackpad is soft to touch and there's also a stylus that resides in a sealed charging compartment in

the rear of the device, so you'll always have it handy.

These finer details are all desirable perks, but the premium Yoga brand has been built on a solid foundation of powerful components. The Yoga C930 we tested wasn't the top of the line configuration, but it was still running a powerful Core i7-8550U quad-core processor. While this efficient chip did get a little hot at 98, it performed surprisingly well in testing, outpacing some higher clocked Core i7-8560U CPUs and even some devices with larger RAM allocations. In PCMark 8's Work accelerated benchmark the Yoga C930 scored 4793, which was around 8% better than the average premium ultrabook running a quad-core i7. This means it's more than capable of breezing through general work and home tasks.

On paper the battery capacity of the Yoga C930 is 60Wh, 10Wh lower than the Yoga 920 we tested last year. Considering the two share

the same processor we expect this to equate to around a 1 hour and 20 minute reduction in FullHD movie playback lifespan from the Yoga 920's 8.5 hours. This is a considerable cut and the only real sacrifice on the updated Yoga, but even with this the Yoga C930 is still one of the longest lasting professional laptops available. Since we tested the FullHD version of the Yoga C930 rather than the power hungry 4K model, the 1080p movie playback lifespan was actually longer here, lasting 9 hours and 17 minutes. Comparing apples to apples however, you'll see a 15% overall reduction in lifespan.

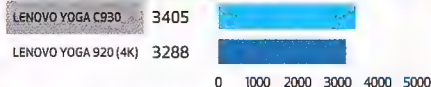
A lot of premium 2-in-1 devices boast a 4K screen, and you can configure the Yoga C930 to have a 4K display for an extra \$210, but the 13.9-inch 1920 by 1080 pixel display will look vibrant and will be detailed enough for most users. This is in part because of a Dolby Vision HDR colour

enhancement that has been applied to both screen variations, giving a much wider overall colour gamut and more vivid colours. This combined with the glossy screen and compact bezels make the FullHD screen excellent for working on.

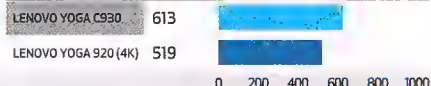
The Yoga C930 has gone backwards on battery life and most models come with only 8GB of RAM, but equivalent devices are about \$350 cheaper than their predecessors. A fair trade as far as we're concerned. On the other hand there have been some considerable improvements to the speakers, the stylus and the display, so we'd say on the whole it's a step in the right direction. ■ Joel Burgess

LABS BENCHMARK RESULTS

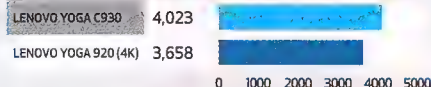
PCMARK 8 - HOME (SCORE)



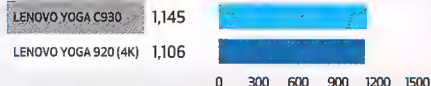
CINEBENCH R15 - CPU (MULTI-THREADED)



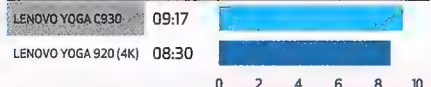
PCMARK 10 - OVERALL (SCORE)



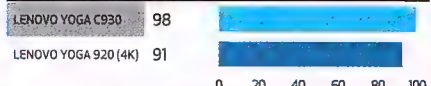
3DMARK FIRE STRIKE (SCORE)



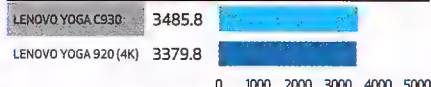
BATTERY LIFE - 1080P VIDEO PLAYBACK (H:MIN)



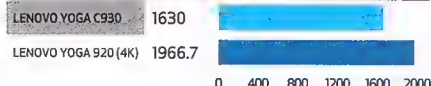
PEAK CPU TEMPERATURE (°C)



CRYSTALDISKMARK READ (MB/S)



CRYSTALDISKMARK WRITE (MB/S)



Verdict

The Yoga C930 takes a small battery hit, but gains some innovative features and a more appealing price-point.





The home of technology

techradar.com



\$211 | WWW.SEAGATE.COM

Seagate Barracuda 510 512GB NVMe M.2 SSD

Can Seagate challenge the market leaders?

Seagate is better known for its hard drive range, but the industry is increasingly transitioning over to solid state. Can it take on the likes of Samsung and Western Digital in performance and price?

The Barracuda 510 512GB is a typical NVMe M.2 2280 (80mm) drive with a PCIe 3.0 x4 interface. It won't be winning any beauty contests thanks to its blue PCB and unattractive text crammed onto its white sticker. Looks aside though, it has a decent set of specifications. Sequential performance looks good with 3400 MB/s read and 2180 MB/s write speeds. An endurance rating of 320 terabytes written is also decent for a mid-range drive.

Seagate's Seatools app is a good piece of software, which along with its DiscWizard cloning and migration app is among the better SSD software suites around.

The Barracuda delivers solid performance without

being exceptional. Its random write performance is strong but this isn't too important for a consumer class drive.

As the Barracuda 510 isn't a particularly chart topping drive, it needs to offer good value to compete in a tough marketplace, and that's where it falls down. At the time of writing the 512GB 510 drive is selling for around \$211 and places it very close to the likes of the Samsung 970 Pro. This drive simply isn't worth that much.

The Barracuda 512GB SSD is a decent performing drive, but until its pricing comes more into line with its direct competitors, then it's tough to recommend it.

■ Chris Szewczyk

Verdict

The Barracuda can't compete while it's one of the most expensive 512GB SSDs on the market.



\$439 | WWW.SEAGATE.COM

Seagate Firecuda 510 1TB NVMe M.2 SSD

A big fish with big performance.

While the Barracuda is aimed at mainstream users, the higher end Firecuda is aimed at enthusiasts and gamers. It comes with some seriously competitive specs. Can it compete on price though?

The Firecuda 510 1TB is of course an NVMe M.2 2280 (80mm) PCIe 3.0 x4 drive. It still has the rather unattractive blue PCB, though at least the sticker isn't covered in text so it'll blend in a little better.

Its specifications are in line with other top drives. Sequential performance is pretty much at the max of the PCIe 3.0 x4 interface at 3,450 MB/s read and 3,200 MB/s write speeds. IOPS are rated at over 620k and 600k read & write while the endurance rating goes up to 1,300 TBW. That's a very good number indeed and it shows Seagate is very confident in this drive.

An enthusiast class drive

needs enthusiast class performance and the Firecuda delivers. It's among the highest performing drives we've ever tested with very strong sequential performance, random writes and IOPS which is reflected in excellent Anvil and AS SSD scores.

As is the case with the Barracuda, the Firecuda's pricing is too high. At around \$439 it's over \$100 more than a Western Digital SN750. While we'd expect the market to mature and pricing to fall, that's simply too much of a margin to ignore. It's a great drive with bad pricing.

The Firecuda 510 1TB can deliver class leading performance, but it matters little with a poor pricing strategy. ■ Chris Szewczyk

Verdict

The Firecuda has what it takes to be a top tier NVMe drive, but its poor value hurts it.





LAPTOP

\$2,999 | WWW.DELL.COM

Dell G7 15

Dell's new G7 15 is thinner than the G5 range, but is Dell just splitting hairs with this new design?

Apart from being 4mm thinner, Dell's new G7 15 is basically identical to the G5 15 that we reviewed back in APC 467. Dell has never been one to miss a niche and often have a number of products with overlapping component sets, but the entire G7 range almost perfectly matches that of the G5 so don't be surprised if you get a little déjà vu reading this review.

Half of the available Dell G7 15 2019 range are running on 8th generation Intel Core i7-8750H CPUs (a trait we first encountered in the Aorus 15 from APC 470) while the other half are running 9th generation Core i7-9750H CPUs. We've only had the opportunity to test one device with the new i7-9750H CPU so the scores may be a little higher than average, but this new chip seems to offer real world boosts between 10 and 25%. Dell sent us a G7 15 with an

i7-8750H CPU and 16GB of RAM so while we can't say exactly how much better it is, the CPU frequency range is 400MHz lower than the 9th generation unit which is 10 to 19% faster between base and boost clock speeds.

While the G5 includes a Nvidia GTX 1050Ti GPU option, the G7 only extends down to a GTX 1660Ti GPU. This makes sense since the latter GPU is newer, cheaper and more powerful than the 1050Ti. The model tested here is running an RTX 2060, but you can configure up to a 2070 for an extra \$400. Across the games we benchmarked, the G7 15 is within 12% either way of the average we have for RTX 2060 GPUs. It did show 61fps on *The Division 2* which was 22.5% higher than the RTX 2060 average, but we expect this to be due to driver updates and game optimisations rather than a genuine performance boost. This configuration is more than capable for 1080p

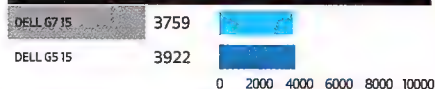
gaming pushing 40+fps averages across modern games on ultra settings and even on *Metro: Exodus* using ray tracing.

Dell has configured the 8th generation CPU models to have 60Hz 15.6-inch IPS panels while the 9th gen models get faster 144Hz and even 240Hz IPS panels. While we'd say that a 240Hz panel is overkill for a mid-range gaming PC, you can get average framerates above 60fps on older and less demanding titles, or by using lower graphical settings, so the 144Hz screen is a solid perk.

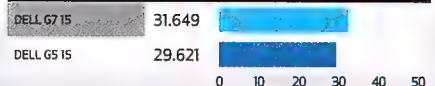
Dell's earlier G series laptops have had a distinctive and appealing aesthetic and although its a little subtle on the Black G7 15, there's still the powder blue thermal vents and the Delorean louvre edge that we love. The super square keyboard has neat white highlights and responsive keys that make it both nice to type on and look at.

LABS BENCHMARK RESULTS

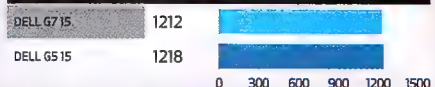
PCMARK 8 - HOME (SCORE)



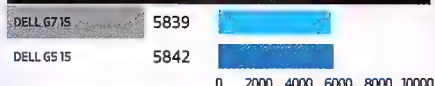
HWBOT X265 1080P (AVG FPS)



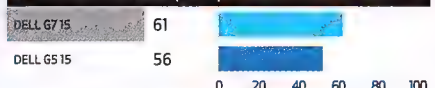
CINEBENCH R15 - MULTI-THREADED CPU



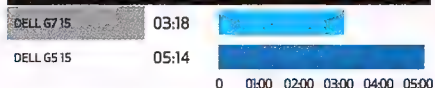
3DMARK TIME SPY (SCORE)



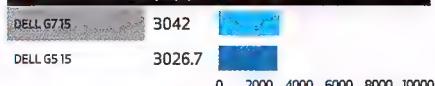
THE DIVISION 2 - ULTRA 1080P (FPS AV.)



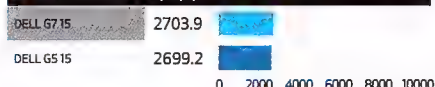
PCMARK 8 - HOME BATTERY (H:MIN)



CRYSTALDISKMARK READ (MB/S)



CRYSTALDISKMARK WRITE (MB/S)



The G7 15 managed to last three hours and 18 minutes in PCMark 8's difficult battery benchmark, which was 17.5% above the average GTX 2060 gaming laptop, but it's significantly less than the five hours and 14 minutes of the G5 15.

We've seen identically spec'd G5 15s (with a 9th-gen CPU) on sale for as little as \$2,209 and the new Aorus 15 with a GTX 1660Ti GPU that offers similar real world performance has an RRP of \$2,399, so the G7 15 is definitely overpriced even if you consider it is 4mm slimmer. **Joel Burgess**

Verdict

If you can get a 9th gen G7 15 its not entirely unreasonable, but there are better laptops available for the price.





ROUTER

\$848 | WWW.ASUS.COM/AU/

Asus ROG Rapture GT-AX11000 802.11ax Tri-Band Gaming Router

Huge in every way.

Despite the rather huge size of this, Asus' gargantuan gaming router only has four Gigabit Ethernet ports though there is a 2.5Gbps W/LAN port to complement the primary WAN. The main features lie inside and a quick glance at the browser-based Dash Board is instructive. The homepage displays the all the main statuses plus live graphs showing network traffic, average network pings, ping deviation(!), global game server pings plus Aura RGB lighting effects for the top logo and settings that configure a programmable button on the chassis. This is in addition to 21 other submenus.

Automated port forwarding is an impressive gaming feature. Rather than researching your favourite game's ports and

fiddling with IP addresses, the Rapture shows you a picture of the game, lets you choose which platform(s) you're playing it on and then prompts you to choose your device from a dropdown menu. The Game Radar section expands on the Dash Board's mini-view where game servers in various countries are pinged for performance monitoring.

There are plenty of other networking features. One is AiProtection which provides Trend Micro-backed network security plus parental controls.

There are all kinds of network monitoring tools that are presented in a way that makes it easy to identify bandwidth hogs and roadblocks. They can also track which devices are visiting which websites which might be handy for concerned parents but gave us serious privacy concerns.

There are VPN terminations, USB file server features and every other network tool you might want.

The Wi-Fi 6 performance blitzed our tests in that it managed to transmit our 115/5 cable internet connection two floors up without any need for extenders. It even did so with 1ms faster ping than rivals. However, the potential throughput is massive with the '11000' moniker reflecting the (theoretical) potential megabits per second it can manage. That's thanks to tri-band compatibility (2.4GHz plus 2x 5GHz) married to an illegal-in-some-countries 160MHz frequency band. In real-world tests it was hitting 120Mbps transfers over 2.4GHz (which is around three times faster than predecessor technologies)

and 500Mbps in 5GHz (which is about the same). However, if you have supporting client technology (like Wi-Fi based upon Intel's 9260 chipset) which supports 160MHz transmission, you can reach insane wireless transfers of almost 1200Mbps (upstream and downstream).

Unless you've been counting the days for such peak wireless throughput, everything about this router is overkill and not nearly worth the money. But that doesn't mean we're not impressed by the technology. ■ Nick Ross

Verdict

Performance that's ahead of its time. But few will get value from buying this absolute unit.





WI-FI EXTENDER

\$245 | NETGEAR.COM.AU/

Netgear Nighthawk X6 Tri-Band WiFi Mesh Extender

Extend your Wi-Fi just by pressing a button.

Not everyone can afford a swanky new Wi-Fi 6 router (or multi-node mesh system), but not everybody needs one. If your Wi-Fi is letting you down and you want to boost it in the simplest, least-intrusive way possible, this Mesh Extender will turn your head.

Mercifully, unlike rivals, it doesn't resemble a very-bulky plug – it actually has a power lead. Setting up involves powering it on and pressing the WPS button. That's literally it. A few minutes later it will have seamlessly-extended your existing Wi-Fi network without appearing as a separate extender network. If you don't like using WPS, then simply connecting to it and adding your Wi-Fi passwords manually works fine.

We tested in our three-storey Sydney townhouse using a Linksys AC router, iPad Pro and a 115/5 Telstra cable connection. We positioned the X6 one floor

above the router and ran our first test next to it. On the 2.4GHz band download speeds boosted from 15Mbps to 19Mbps. Another floor up it managed 8.2Mbps (up from 4.7Mbps). Meanwhile, on the 5GHz band, first-floor performance boosted from 22.8Mbps to 24.5Mbps while on the top floor it went from 11.1Mbps to 23.8Mbps.

These are rather modest improvements and we expect more for the money as rival extenders cost less-than-half and mesh systems are only slightly dearer. That said, the ease of use and ability to maintain just one network name will be attractive to many. ■

Nick Ross

Verdict

The simplest way to extend your Wi-Fi. But performance isn't spectacular.



CASE

\$115 | WWW.THERMALTAKE.COM.AU

Thermaltake H200 TG Snow RGB

An affordable case that offers beautiful simplicity and user friendliness.

Isn't it refreshing to see a case that doesn't look like it belongs in a Transformers movie! Thermaltake's H200 Snow is a case that's delightfully modern and subtle. The Thermaltake H200 is a white mid-tower chassis capable of holding a full sized ATX board and GPU. It comes with one 120mm fan. It can house two dual fan radiators, giving it excellent cooling capabilities. It's also got a tempered glass full window and a PSU shroud to hide ugly cables.

Building a system with the H200 was a breeze. The case is full of thoughtful cable management features with well-placed holes and indentations meaning even thick PSU cables can be routed and hidden with ease.

The H200 comes with an attractive RGB light bar along the left front of the case. An adjacent TT logo is also lit. These are controlled by a button on the top of the

case. Seven pre-set colours can be set to breath, remain fully lit, or they can be cycled through. In total there are 19 modes. Of course you can turn it off too if you prefer.

Judging a case on looks is always subjective, with opinions depending on the eye of the beholder. The H200 Snow Edition should appeal to users looking for something easy to work with whilst offering a fantastic subtle look that allows the focus to be on the build thanks to the tempered glass window. Thoughtful design cues, cable management options and affordability make the H200 an excellent case, and easy to recommend.

■ Chris Szewczyk

Verdict

The TT H200 looks fantastic, it's also great value and super easy to work with.





ROUTER

\$683 | WWW.ASUS.COM/AU/

Asus AiMesh AX6100 Wi-Fi System

Our new favourite wireless router.

Thanks to their range and performance, AX routers have been destroying the mesh Wi-Fi market so our first thought was, "What's the point of having AX-based mesh Wi-Fi?" Could this be more Asus overkill? It didn't take us long to find out what the fuss was about.

We've been testing Wi-Fi equipment in various Sydney premises for a long time. In recent years, testing has distilled into running Ookla's Speedtest over WLANs because it provided the simplest, most relatable and most reliable method of comparing relative networking performance across devices. Throughout this time, however, our primary home PC has been sat, two floors up, connected via powerline adapters because the resident gamers could not rely upon the best wireless devices to beam a robust-enough gaming

signal up two flights of stairs. Was today the day?

Each of the RT-AX92U nodes is a mini router, complete with WAN port and four Gigabit Ethernet ports. Both are significantly smaller than traditional routers despite offering comparable performance and features. We plugged one into our Telstra cable modem which offers reliable 115/5 Mbps speeds and placed the other next to our primary PC. This configuration is usually not permitted by two-node Mesh networks as having a node-less coverage gap on the first floor usually decimates top-floor performance. Even with three nodes (one on each floor) you get some drop off as you go up.

Nonetheless, with the two-node, wide-gap, mesh activated we experienced bomb-proof maximum internet speeds, across all devices, at all points of our

home even when simultaneously streaming 4K video to a TV and YouTube to the kids' ancient Android tablets.

Next we tested the PC. Over the powerlines, internet performance fluctuates between 70Mbps and 90Mbps with a ping that varies between 12 and 16ms but it's otherwise solid enough for gaming. However, with Asus' AX Mesh setup, ping was a constant 12ms and internet speeds were consistently maxed out with no discernible fluctuation. We performed a 40GB FTP file transfer from a directly-connected USB 3 drive and achieved consistent 48MB/s transfer speeds (386Mbps). While this is some way below the theoretical maximum of AX Wi-Fi (even AC Wi-Fi) the reality is that, for the first time, the AX-based, 4804Mbps-rated, backhaul connection provided wire-like stability

two storeys above our modem. So, for the first time, we didn't miss having an Ethernet cable.

Everything is simple to set up and, with the exception of the elaborate gaming settings, it sports all of the security and network management features that its ROG Rapture cousin provides. Everything can be easily managed via browser or smartphone app.

It's not cheap but we've finally cut the cord to our primary gaming PC and if you've felt limited in a similar way, the Asus RT-AX92U 2 Pack can prove to be liberating. ■ Nick Ross

Verdict

Not cheap, but it will likely be the only home networking equipment that you'll ever need





SMART PHONE

\$1,499 | WWW.OPPO.COM/AU

Oppo Reno 5G

Cutting edge, future-ready and relatively affordable.

Ever one for classy designs, Oppo's latest handset is truly stunning. The Reno 5G sports an iridescent, yet predominantly matte finish on its rear – a welcome aesthetic and tactile change to all the high-gloss that arrived on flagship phones with the introduction of glass bodies. A clever addition to the phone's back is a small bump (dubbed the 'O-Dot') that effectively raises your phone from a flat surface to avoid damaging the cameras and sensors that are flush with the handset's rear.

Flip the phone over and you'll immediately notice how dazzling the display is as well. Measuring 6.6-inches and fitting in an impressive 2,340 x 1,080 pixels, this AMOLED wonder offers plenty of vivid colours and detail. While there is a tiny bezel that surrounds all four edges (a slightly larger one for the chin), the lack of notch or pinhole camera makes for

an impressively uninterrupted viewing and gaming experience, enabling it to achieve a stellar 93.1% screen-to-body ratio.

The reason this handset is able to maintain such a sleek facade is due to its novel and genius pop-up camera. Oppo isn't new to this, with the Find X first debuting this flavour of wizardry, but the shark-fin design we see with this generation of smartphones is certainly a refinement on the feature. The selfie camera is quite a capable shooter, and paired with portrait modes and Oppo's penchant for beautification, it'll be more than enough. As for the main snapper, this version of Oppo's flagship has inherited its non-5G counterpart's star feature – 10x optical zoom – and when paired with all the powerful shooting modes, makes for a really deep and pretty camera.

Its powerful Snapdragon 855 and 8GB RAM combo is more than capable of breezing through the latest

games and day-to-day tasks. Thanks to Oppo's VOOC technology, the massive 4,065mAh battery charges up incredibly fast and comfortably manages more than a day's worth of heavy usage. While Oppo's ColorOS isn't necessarily as appealing as some other major players', it's certainly improved over the years and is more than palatable by this stage.

While the 5G competition is thin at present, this flagship from Oppo is the most affordable 5G-enabled device on the Australian market, with its \$1,499 asking price falling comfortably below the \$1,729 of the LG V50 ThinQ 5G and the anticipated \$2,000 ballpark for the Samsung Galaxy S10 5G. At the time of writing, 5G availability was rather patchy in Sydney, although even in areas that weren't technically marked by Telstra as having coverage, download speeds were noticeably quicker (getting up to 200Mbps in some CBD areas according to

Speedtest, compared with the 40-60Mbps typically expected of 4G).

Although having 5G capabilities might prove itself useful over the course of the next year, by that point the number of compatible smartphones on the market will have also increased. You could spend \$300 less and get an identical handset minus the 5G functionality – a much more compelling proposition for the majority of users – but if you'd like to ready yourself for the future and are fine with being an early adopter, the Oppo Reno 5G is an excellent way to buy into all the latest smartphone features at a discount. ■ Harry Domanski

Verdict

A competitively priced high-tech offering.





RASPBERRY PI

\$59.95 FOR 1GB (2GB \$77.95, 4GB \$95.95 | WWW.RASPBERRYPI.ORG

Raspberry Pi 4 B

Les Pounder loves a surprise and a Raspberry Pi –so when the Pi 4 was released, he was over the moon!

Surprise! Mid-year is not a traditional release date for a Raspberry Pi. In fact, this new version of the Pi breaks a few traditions. Firstly, it was released far earlier than predicted due to the BCM2711 System on Chip (SoC) being ready for production some nine to 12 months early. Secondly, there's the price: there is now not just one price for a Raspberry Pi Model B, but three. At \$59.95, the basic model comes with 1GB of RAM; for \$77.95 there is a 2GB model; and for \$94.95 there is a 4GB model. For this review we have chosen to look at the 1GB model as we can directly compare it to previous models of Pi.

No matter the version of Pi 4, all come with a 1.5GHz 64-bit quad-core Arm Cortex-A72 CPU (Arm v8, BCM2711B0) and all of the RAM is now LPDDR4, giving us a much-needed boost in performance. GPU duties are handled by the new VideoCore VI which supports OpenGL ES3.0 and provides another handy

boost in performance.

If you are a keen maker/hacker then fear not, as the 40-pin GPIO is present and fully compatible with HAT and pHAT boards. But in a change to previous GPIO configurations, the GPIO of the Pi4 offers four each of I2C, UART and SPI interfaces, enabling more compatible devices to be connected – all by changing the device tree overlay on boot.

For network connectivity, we are truly spoilt. While the Pi 4 retains the excellent 2.4GHz and 5GHz Wi-Fi from the 3B+, we finally have true gigabit Ethernet on a Raspberry Pi thanks to the BCM54213 Ethernet chip, which provided a stonking 931Mbps/sec in our test – around three times faster than the 3B+. No more Ethernet through USB!

Talking of USB, the Pi 4 has four USB ports – two of which are USB 2.0 and the others USB 3.0, which have their own chip that connects to the SoC via PCI-E! Yes, we can now connect high-speed

USB drives to the Pi for projects such as media centres and file servers. We can also boot from USB devices, so adding a cheap SATA SSD via a USB interface will massively speed up your Pi and provide very cheap and plentiful storage for servers.

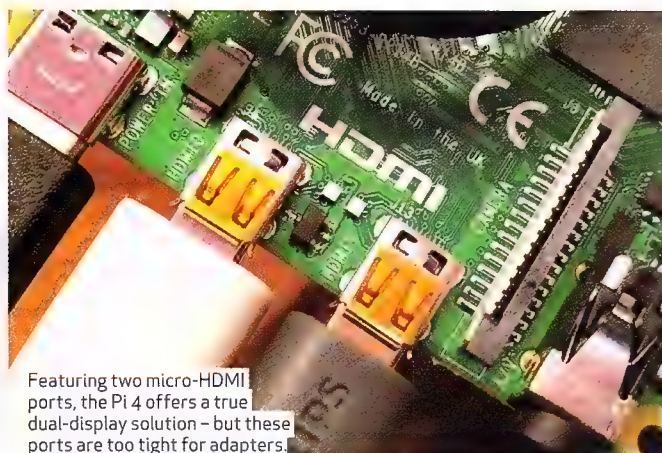
To power the Raspberry Pi 4 there is a USB-C connector in place of the old micro-USB port. The USB-C port provides 5V at 3A (15W), which at idle is approximately 4W and 8W when under load. Since launch a minor flaw has been discovered with the Pi's USB-C implementation, so it can't be powered by e-marked USB-C cables – such as those supplied with Apple laptops – this will require a board revision to fix.

While 15W may seem like overkill, it provides plenty of power for the Pi 4 and plenty of spare power for use by USB 3.0 hard drives. The current draw at idle for a Pi 4 is much greater than a Pi 3B+ – 600mA versus 400mA – and so that means a bigger battery is required.

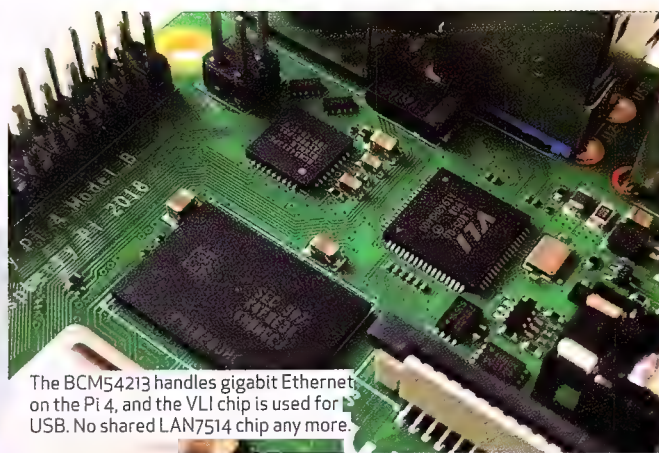
In fact, from cold the Pi 4 consumes around 960mA during the boot process.

If you plan to reuse an older official Raspberry Pi power supply (5V at 2.5A, 12.5W), you can purchase an adapter to change micro-USB to USB-C. Power can also be provided directly to the Pi via the GPIO, but this will bypass any regulators, so check your voltages before connecting. If you need Power over Ethernet (PoE), you'll be happy to know that the PoE HAT is compatible.

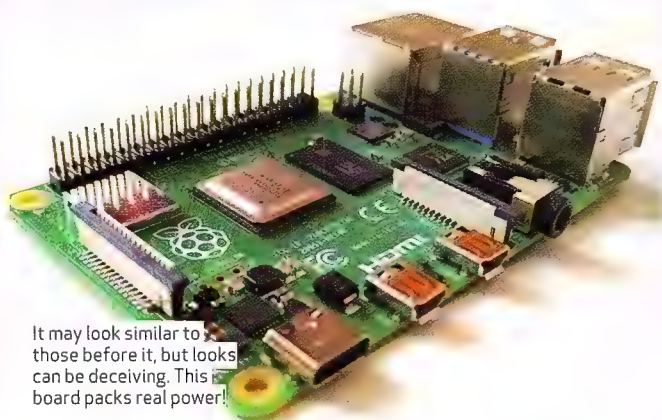
With all this new power there has to be heat, and this is where the Pi 4 differs to previous boards. To be clear, the Raspberry Pi 4 runs really warm at idle: around 52 degrees C two minutes after booting up. The temp increased to 66 degrees when under load during a Sysbench CPU stress-test. The board can reach temps of up to 80C and so this means that active cooling is a must. We ran the same idle and stress-test sequence on the Pi with a Pimoroni Fan Shim, and this dropped the



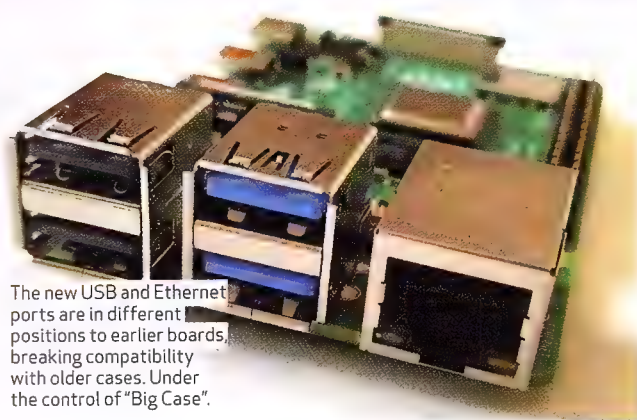
Featuring two micro-HDMI ports, the Pi 4 offers a true dual-display solution – but these ports are too tight for adapters.



The BCM54213 handles gigabit Ethernet on the Pi 4, and the VLI chip is used for USB. No shared LAN7514 chip any more.



It may look similar to those before it, but looks can be deceiving. This board packs real power!



The new USB and Ethernet ports are in different positions to earlier boards, breaking compatibility with older cases. Under the control of "Big Case".

idle temp to 36 degrees with the CPU stress-test temp at 46 degrees. We have been advised of an imminent firmware fix that will address these thermals.

Another new feature on the Pi 4 are the dual micro-HDMI ports offering dual screens at 4Kp30, or a single screen at up to 4Kp60. Video is also decoded by a dedicated chip, so there's no hit on CPU performance. But why is this necessary? Well, to be honest it isn't something that most users will take advantage of. But 4GB users who may be using their Pi 4 as a desktop replacement can enjoy an extra screen. Typically coders and writers employ two screens for reference and work.

To use the Raspberry Pi 4 we need to be running the very latest version of Raspbian; older versions will not work with the Pi 4 but the latest Raspbian will work on every model of Raspberry Pi. Based upon Debian Buster

(unreleased at the time of writing), the latest Raspbian is impressive and nimble. It booted on our Pi 4 in just under 18 seconds and, after a few hiccups, detected our dual-screen setup, giving us 3840x1080 of screen for projects – lovely stuff!

The Raspbian desktop is very usable with Pi 4 and it feels just like a traditional desktop computer. We ran our usual Sysbench single- and quad-core CPU stress-test, and the Pi 4 shaved almost 30 seconds from the Pi 3B+ single-core test: 119.3 seconds for Pi 3B+, 92.7 seconds for Pi 4. In the quad-core tests the Pi 4 scored 23.3 seconds versus the Pi 3B+ time of 31.8 seconds. The Pi 4 also blazed through our Octane benchmarks with a score of 7274, 2.6 times quicker than Pi 3B+.

But where the 1GB version will struggle is with resource-heavy apps – Chromium is the main

culprit. Watching a video at 720P in a window is bearable; make it full-screen and 1080P and it becomes a slideshow. There is a future update planned to address these launch issues, so we shouldn't have to wait long for a fix.

The questions that the Raspberry Pi 4 raises are "Who is this board for?" and "Why do we need this much power?" To be blunt, the Pi 4 does offer a lot of power, but most makers will not take full advantage of it. The Pi 4 offers entry-level desktop performance and for \$60 - \$95 that should be applauded. But for most hobbyists who make GPIO-based projects, robots, or who are learning to code, then sticking to a Pi 3B+ and using the latest Raspbian release will offer all the latest Debian Buster features at no extra cost. Anyone looking to upgrade their Raspberry Pi would be wise to wait for a while

until Debian Buster and the Pi 4 software gains a little maturity. Don't get us wrong – the team have done marvellous work with the Pi 4, but the software hiccups need to be ironed out before consumers get their hands on one.

If you have been waiting to run your own low-power Linux home server, then the Pi 4 is the board of your dreams! There's lots of power, gigabit Ethernet, USB 3.0 and Debian stability. The other bonus for all users, no matter what version is purchased, is the immense library of support and documentation provided by the Raspberry Pi Foundation. ■ **Les Pounder**

Verdict

Truly powerful with great support, the Pi 4 offers so much, but it needs a little time to work out some hiccups.





VR HEADSET

\$649 | WWW.OCULUS.COM

Oculus Rift S

More Oculus Rift 1.5 than a true successor.

The Oculus Rift S should represent the next leap forward for the company's high-end, PC-based virtual reality experiences. But in practice, this is more of a baby-step – the Oculus Rift S is not a true “Oculus Rift 2” successor.

First, the fit. Whereas the Rift (and Quest) used a thin rubbery strap that went over your crown and around the back of your head to two firmer points over your ears, the Rift S adds a padded plastic curved mould where your forehead and base of the skull are. There's still a velcro strap for positioning the headset, but it's now primarily tightened by a dial on the back headrest. It's comfortable enough, though it in fact feels heavier than the original Rift in terms of its frontal weight distribution.

There's a good reason for this though – the Rift S does away with external motion tracking sensors, which previously required you to use up USB ports on your PC

and trail cables around your room and desk, in favour of outward facing cameras. These are used to track your position in the room and the movements of the superb Oculus controllers in your hands (an included part of the package here).

A pair of touch controllers ship with the Oculus Rift S, and these are slightly different to their predecessors. In play, you won't notice any difference against their older stablemates.

However, not all the changes are necessarily for the better. Firstly, the Rift S has ditched the Rift's over-ear earphones in favour of directional speakers in the headband. On the one hand, they offer a reasonable sense of directional audio in relation to what's happening in the scene in front of you, while also letting your unobstructed ears listen out for what's happening in the real world. After all, with your senses obscured by the VR world, it's handy to be able to have an ear out for

what is happening in the game world around you.

Internally there are changes too. The Rift S swaps out the first Rift's dual OLED screens for a single LCD upping the resolution to 2560 x 1440 for what should be a sharper image.

But it also reduces the refresh rate from 90Hz to 80Hz. This is intended so as to keep the price down as well as keeping the minimum specs for the device the same as that of the Oculus Rift, letting more people get onboard without having to upgrade their PC gear. But it also runs the risk of aggravating those that suffer from VR-induced motion sickness, with the screens not updating at a rate your brain perceives to be natural.

The Oculus Rift S has had to sacrifice greater audio and refresh rate to make it more accessible, and does very little to appeal to those that have already invested in the Oculus ecosystem. On top of that, the actual experience of wearing a VR

headset has, for better or worse, remained more or less unchanged – whether that's something you'll find fascinating and comfortable, or isolating and nauseating, or otherwise.

Which makes the decision to not jump in with two feet and push the limits of VR even further forward tough to extrapolate. Who is this for? If the original Rift didn't coax the casual, I'm not certain that an improved set-up experience will shift the dial for those still on the fence. And so not to cater to the dedicated hardcore VR fan leads us to believe that Oculus runs the risk of letting its most loyal fans begin to eye-up the Valve Index instead. ■

Gerald Lynch

Verdict

A good first VR, but certainly not an upgrade for existing owners.



software

» APPS FOR ALL YOUR PLATFORMS



Windows SOFTWARE

Affinity Publisher

Impressive publication software with incredible integration with the Affinity suite.

\$62.99 | AFFINITY.SERIF.COM

Affinity Publisher is the third major piece of software in the Affinity suite from Serif. It follows Affinity Photo and Affinity Designer and builds off of their strengths. It's an impressive piece of dedicated publishing software which can be used for designing magazines, books, programs, and many other items that you'd print or publish. It integrates with the Affinity suite seamlessly thanks to its StudioLink technology. While Affinity Publisher has the feature set and power for professional publishers, many will shy away from it due to its lack of support for InDesign files.

There are two ways to look at Affinity Publisher: as a standalone publication app; and as an integrated part of the Affinity suite through its new StudioLink technology. By both of these measures, Affinity Publisher is an impressive application with enough power to handle the vast majority of publishing needs.

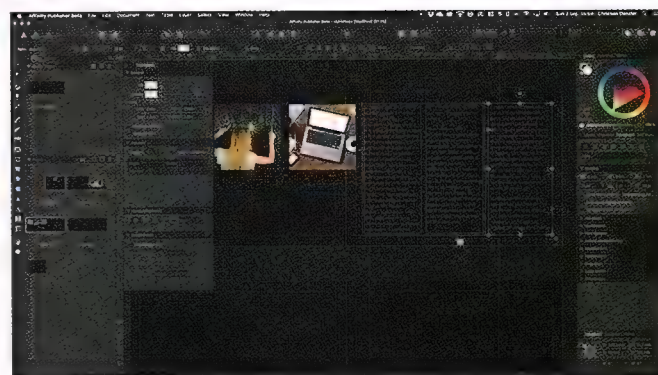
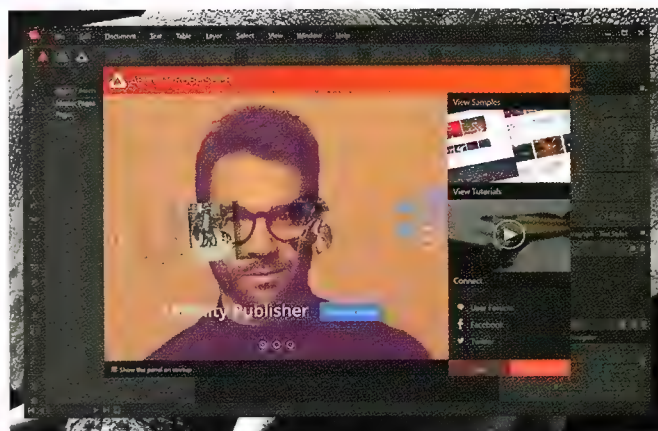
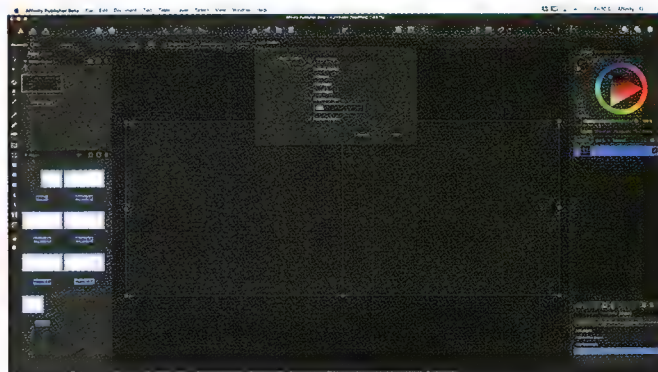
While Affinity Publisher can be used as a standalone app, its flagship feature is StudioLink, which allows it to integrate with Affinity Photo and Affinity Designer seamlessly. If you have all three programs on the same PC, you can tap the Photo or Designer studio icon to use all of the respective app's features directly within Affinity Publisher.

One of the best things about Affinity Publisher is that it doesn't require a subscription. It costs \$62.99, and that's it. Compare that to Adobe InDesign, which costs \$29.99 per month, and the price difference is massive if you use the product for just a few months.

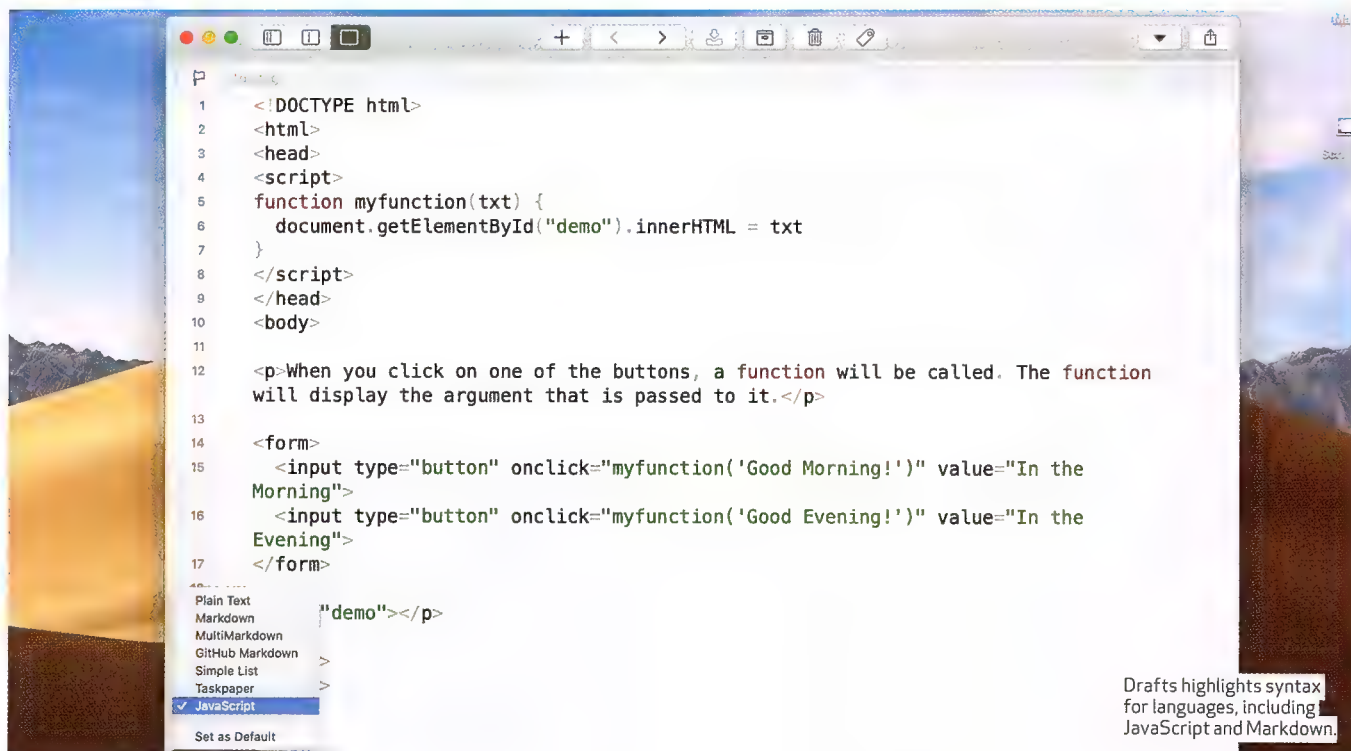
If you want to create anything from website mockups to magazines, Affinity Publisher is an excellent tool. It has a clean interface, enough power to handle complex jobs, and has an impressive feature list. Its integration with StudioLink is one of the most impressive things Serif has ever released. It allows you to edit photos, vector art, and publication pages within the same app.

Despite all of the features and the excellent StudioLink integration, many professionals will never use Affinity Publisher and never could. That's because Affinity Publisher doesn't support (InDesign Document) INDD files. It also doesn't support InDesign Markup Language (IDML) files, though Serif states IDML support will come at some point.

If you work in an industry in which Adobe file support is essential, Affinity Publisher probably isn't for you. But if you don't need Adobe file support or you own or run a business that is considering switching away from Adobe, Affinity Publisher is a professional-grade all-in-one publication tool that doesn't require a subscription. ■ Sean Endicott



Mac » APPS



Drafts

A speedy way to create notes on your Mac.

FREE, OFFERS IN-APP PURCHASES | AGILETORTOISE.COM | NEEDS MACOS 10.13 OR LATER

Drafts claims to be the **quickest way to capture ideas and tasks**, and it's been a big hit on iOS.

It's now available for Mac, letting you create new notes ('drafts') in several ways: you can click on the menu bar icon to bring up the Drafts pop-up; you can create a note in the main app window; or you can highlight an item in another app and use the share sheet to send it to Drafts. This option creates a new

draft without switching into the Drafts app. You can also create your own keyboard shortcuts to send whatever's in your Mac's clipboard to the app as a new draft.

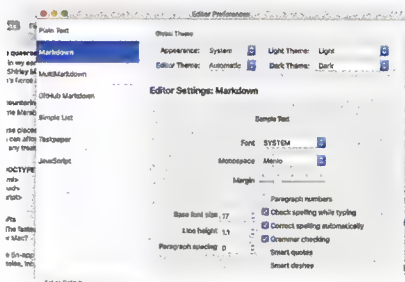
Drafts has automatic syntax highlighting: Markdown (the default), MultiMarkdown or GitHubMarkdown, JavaScript, SimpleList, TaskPaper or good old-fashioned plain text. You can tag or flag notes as you go for easy retrieval, and you can change the formatting defaults. Navigation is simple and effective, and there's a useful versioning tool that makes it easy to browse different versions of a draft.

ACTIONS REQUIRED

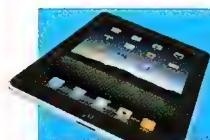
The core app is free, but to unlock some of the more advanced features you'll need to sign up for a Pro subscription. This is cross-platform, and it gives you extra widgets, more sharing and capturing options, editor themes, as well as multiple

workspaces. In iOS, the Pro version can also create and edit Actions. Actions are a key reason for Drafts' iOS success, and they provide lots of automation options for manipulating notes and using them in other apps. They aren't currently available for the Mac version, but the Mac app does include the URL schemes from its iOS counterpart. These enable other apps to send data to Drafts using URL callbacks; for example, you can create a URL to make a new draft or open a specific one, replace characters or search for particular content.

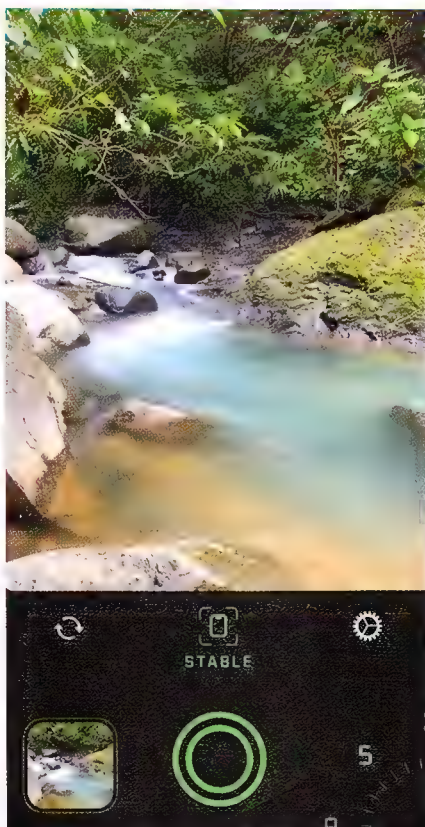
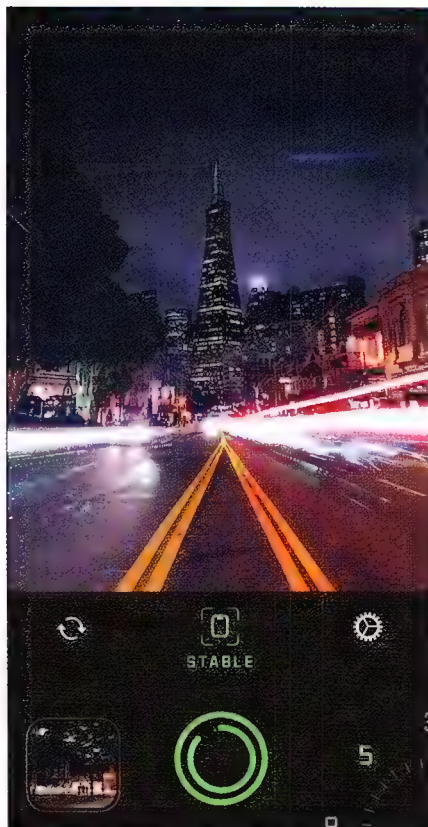
While full Actions support is promised for later versions, the current lack of it means that Drafts on the Mac is considerably less powerful than its iOS sibling and the Pro subscription is considerably less tempting. Nevertheless, Drafts on the Mac is a solid and useful note-taking app that's great for capturing ideas quickly. **Carrie Marshall**



There are lots of customisation options, but themes are limited and some are locked if you don't have a Pro plan.



App Store » iOS APPS



Spectre Camera

Take iPhone shots to the next level.

\$2.99 | CHROMANOIR.COM | NEEDS IOS 11 OR LATER (AUTO SCENE DETECTION REQUIRES IOS 12)

Spectre Camera enables you to create images with light trails, dreamy-looking water or shots which appear to have no people or traffic in them.

Rather than your iPhone's camera running a single exposure for a long time, it shoots hundreds of exposures for your chosen time, then blends them.

You just compose your frame, press the shutter and let it go to work. You can cycle through shutter speeds, and the on-screen stabiliser uses a device's accelerometer to let you know when the camera's stable enough to get going.

Our test images were adequately (rather than extremely) sharp – fine for online sharing or small-scale printing. The app also records the entire process and saves it as a Live Photo.

The developer claims that it can be used to shoot long exposures handheld. We found that this resulted in very blurry images.

Using a tripod gave the best results.

Spectre is easy to use, affordable and fulfils its purpose well. If you're looking to elevate late-night photographs or shots with moving subjects, this app is for you.

Dave Stevenson

Capsicum

Planner, notebook and tracker.

\$1.99 MONTHLY/\$19.99 ANNUAL SUBSCRIPTION | CAPSICUM.APP

| NEEDS IOS 12 OR LATER

Capsicum combines a daily planner with a habit tracker and notebook. The Planning section allows you to view events, to-do list items, notes and a weather forecast for the day. And tabs along the top of the screen make it easy to swap between weekly or monthly views.

Swap to Habit Tracking and you can add items like exercise or meditation, and set alerts for each. The Loose Leaf section allows you to add lists or notes. You can create multiple notebooks, customise covers, and change font and text colour. You can also create Siri Shortcuts to log your habits.

Things then get a bit muddled. While you can add to-do list items in Loose Leaf or Planner, those you add in Loose Leaf don't show up in Planner. You must also choose the correct notebook before viewing what's lined up for the day. The cover and font options are also a bit cheesy, and the iPad version doesn't make good use of the additional screen space.

There are more elegant planners (such as Moleskine Timepage, for example) and better productivity apps (like Things). Capsicum doesn't do the whole job well enough to tempt us away from those.

Kenny Hemphill

Style

Title

Untitled Notebook

Cover Style



Navy Gold Notes



Orchids



White & Copper Stripes

Wh

Primary Color



Default Decorative Tape



Default Heading Style





Google Play » ANDROID

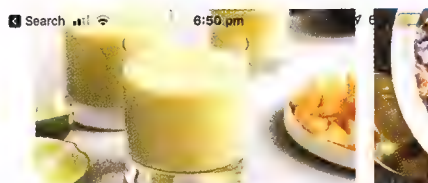
Deliciously Ella

Plant power.

\$1.49 A MONTH | DELICIOUSLYELLA.COM

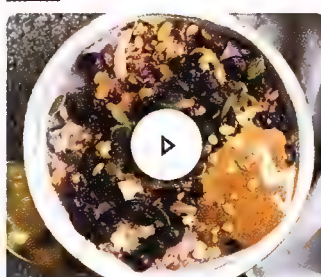


Deliciously Ella – which has been around for a while, but seems to have recently revamped its app – is focused on clean eating and yoga. It's got a nice clean UI that's easy to navigate, and the food – which focuses on simple recipes with easy-to-find ingredients – looks great in the pictures. The recipes are all vegetarian, and although there's no calorie information given the app focuses on health and wellbeing. Recipes come with full instructions as well as videos, making them easy to follow, and the simple swipe controls mean that keeping track of what you're doing while in the kitchen is easy. All in all, it's a pretty great source of vegetarian recipes, whether you're a vegetarian yourself or just looking for healthier food options. The yoga videos are divided by difficulty, and provide nice, clear instructions for each activity. The recipes are a larger focus than the yoga, but this app generally seems like a great source of good life advice. The subscription fee is mercifully light, too.



Mango, Pineapple & Avo Smoothie

Popular Videos

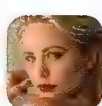


Buckwheat & Ginger Granola

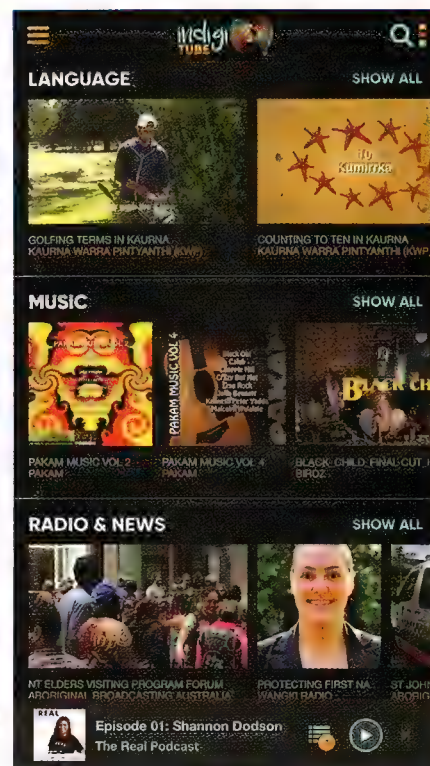
Home Recipes Yoga Profile

Jesinta Franklin Official App

Ms Universal app.



Franklin, the winner of Miss Universe Australia 2010 and a model and TV presenter, has apparently poured everything into this app. Hopefully it works out for her, but to get the most out of this lifestyle app – which compiles recipes, workout routines, beauty tips and little bits of prose – you'll need to be a big fan of hers. There's an assumed fandom in some of these items, like her posts of behind-the-scenes photos from a fashion shoots and her blog entries, so don't expect a be-all-end-all lifestyle app that's agnostic to who created it. Content quality varies; there's a daily 'thought of the day', which is generally a simple quote, sometimes with some context about the person who said it. The workouts and recipes are often extremely simple (although the pre-recipe paragraphs are, mercifully, shorter than they are on a lot of cooking sites), but her makeup and skincare advice is a bit more detailed and come complete with videos. If you're a huge fan it's worth checking out the 14-day trial, but otherwise \$7 a month feels very steep.



IndigiTUBE

Always has been, always will be...

FREE | INDIGITUBE.COM.AU/



IndigiTUBE, the app for the website of the same name, is something special. It's an incredible resource of

indigenous podcasts, radio stations, music and videos, all easily accessible and all completely free. This app has clearly been designed with both education and access in mind, with a huge number of stations and videos on there. There are musical performances, complete with video, interviews, and a lot of videos on indigenous languages, if you're inclined to learn important terms in our native languages. There are radio stations from all over the country, which can be accessed immediately and easily. There's even a claymation based on Bush Mechanics (but not the original series, unfortunately). There's a huge amount of content on there – as I write this I'm listening to a recording of the Indij Hip Hop Show from April. With an excellent UI and informative pages attached to each video and audio program, IndigiTUBE is a fantastic, important app – the sort of app that will, we suspect, work its way into some school curriculums in the future, if it hasn't already. ■ James O'Connor



Robolinux 10.5

Mayank Sharma isn't too gullible in real life, but has an uncanny tendency to fall for distros that then don't deliver on the claims they make.

FREE | [HTTPS://ROBOLINUX.ORG](https://robolinux.org)

Never one to judge a book by its cover, we let slide the fact that Robolinux's website is very messy and a nightmare to navigate. Sure, we appreciate the fact that donations are key to sustaining the open source ecosystem, but we think this project goes a little overboard. Its developer's heart is in the right place; he isn't just seeking donations for himself, but that's no excuse for the poorly designed website.

Robolinux has three active branches: Raptor 8, based on Debian; Raptor 9, based on Ubuntu LTS; and Raptor 10, based on Ubuntu. Each branch has a bunch of releases for different desktop environments, including Cinnamon, GNOME, Xfce, MATE and LXDE, for a total of 15 ISO images. Once you do manage to navigate your way to the downloads page, you find that they're actually hosted on SourceForge.

The ISOs are hefty compared to other distros, ranging between 2-4GB. There's obviously no shortage of pre-installed apps and you can get more using the distro's unique one-click installers. When we last looked at the distro in LXF227, the project was charging US\$10 for them. Unless you shelled out the money, you couldn't install any of these apps. That's changed now and you can grab the installers from the project's website. The apps are essentially just shell scripts that use apt to get the apps.

We have two issues with Robolinux's approach. The first is that while they do just take a single click to install, it takes dozens to grab the scripts from the project's website. Secondly, the project does a disservice to the open source community by claiming the scripts will help save users several hours spent resolving dependencies if they were installing the apps manually. They don't make any mention of dependency-resolution binary package management tools like apt, which is what they themselves use in the scripts.



"The documentation on the website is negligible and isn't properly arranged."

Then there's the other highlighted feature of the Robolinux project, dubbed Stealth VM. Together with another script descriptively named C-Drive-to-VM, this helps you move your physical Windows installation into a virtual machine. Again, both scripts were available only after the payment of a small fee, but are now available for no cost. Peer under the covers and the process is pretty much the standard affair. C-Drive-to-VM gives you a couple of freeware utilities to resize your Windows partition and fold it into a VHD file. After moving the VHD file to your Linux installation, use Stealth VM to first convert it into VDI and then import into a VirtualBox VM. We aren't fans of the project shielding this information from its users and projecting it as a novel approach.

The distro also appeals to privacy-conscious users by inviting them to use a script to route all its traffic via a VPN, which is also Robolinux's third distinguishing feature. This too is a

disappointment as the service it relies on requires users to have a paid account, which is a fact that is conveniently missing from Robolinux's website. Once again, we aren't against paying for a service, but it's the project's lack of clarity that upsets us.

Lastly, for a distro that targets new users Robolinux doesn't have a public forum board. Instead guaranteed support is doled out by the developer himself – for a fee. There is an option to email your tech support queries for free, but that's no excuse for not hosting public forum boards. The amount of documentation on the project's website is also negligible and isn't properly arranged inside a dedicated menu, which make it hard to access.

Sure, projects need to sustain themselves – but the tactics employed by Robolinux not only make it look shady but also reflect poorly on the larger open source community as a whole. ■

Graphics card wars

AMD's 5700/XT vs Nvidia's new Super series mid-range cards do battle

If you've been reading our recent issues, you would surely have seen that AMD stole most of the headlines from Computex onwards. Ryzen CPUs! Navi graphics cards! Hold up though. Nvidia has something to say about the latter. Nvidia's mid-life refresh of its RTX 2000 series has arrived in a timely fashion. The RTX 2060 Super and RTX 2070 Super are ready to take the fight to AMD's long talked about RX 5700 and RX 5700 XT. Let the latest battle in the GPU wars commence.

MARKET POSITIONING

Nvidia's Turing GPUs are a well known quantity having been on shelf for some time. The Super cards don't introduce anything as far as new technology is concerned. You still get the key Nvidia features. Ray-tracing support, DLSS and things like Nvidia's outstanding power efficiency all carry over. If we're to sum up the Super cards quickly you can think of the 2060 Super as essentially replacing the 2070, while the 2070 Super is a 2080 that's just a little slower. The Super series is all about adjusting the price/performance ratio of the mid-tier RTX cards, and combatting the new threat from AMD's RX 5700 series. Additionally, the RTX 2080 also gets the Super treatment, though we'll be covering that separately in our next issue.

In contrast, AMD's RX 5700 and RX 5700 XT Navi GPUs are very much new and undoubtedly AMD's most anticipated 2019 GPUs. It brings key new technologies including a new architecture called RDNA, 7nm process technology and PCIe 4.0 support. The 5700 series are the products AMD will use to bring it to competitiveness in the all-important mid-range market.

VALUE AND PRICING

We got a wealth of information about Navi at AMD's press conference at Computex, including pricing. Did AMD play its hand too early and give Nvidia time to respond? Is the Super series a reactionary release? Of course you can't just whip up new GPUs in a few weeks, so obviously Nvidia has been planning for this for many months. The Super launch did create an unusual situation where AMD adjusted its pricing publicly before the 5700 even launched. Even then though, we're concerned that mid-range pricing continues to creep higher. The cheapest of these cards is \$549. It's just too high for too many gamers.

Looking at the GPUs themselves, in some ways these cards shouldn't even be competing with each other on price. At 251mm² the 5700 die size should theoretically give AMD a competitive yield advantage over the 2060 at 445mm² not to mention the 2070 at 545mm². It will be interesting to see how the market and pricing matures. With those die sizes, along with AMD's process advantage, you would think the 5700 would have a lead in power efficiency, but sadly this isn't the case as AMD has clearly used its power budget to push clock speeds in order to extract maximum performance. It's going to be interesting to see how AMD develops RDNA given one of its design goals is power efficiency.

To quote Gandalf: 'The board is set, the pieces are moving. We come to it at last.' It's time to see just how these cards stack up against one another in the battle to win the hearts, minds and dollars of gamers.



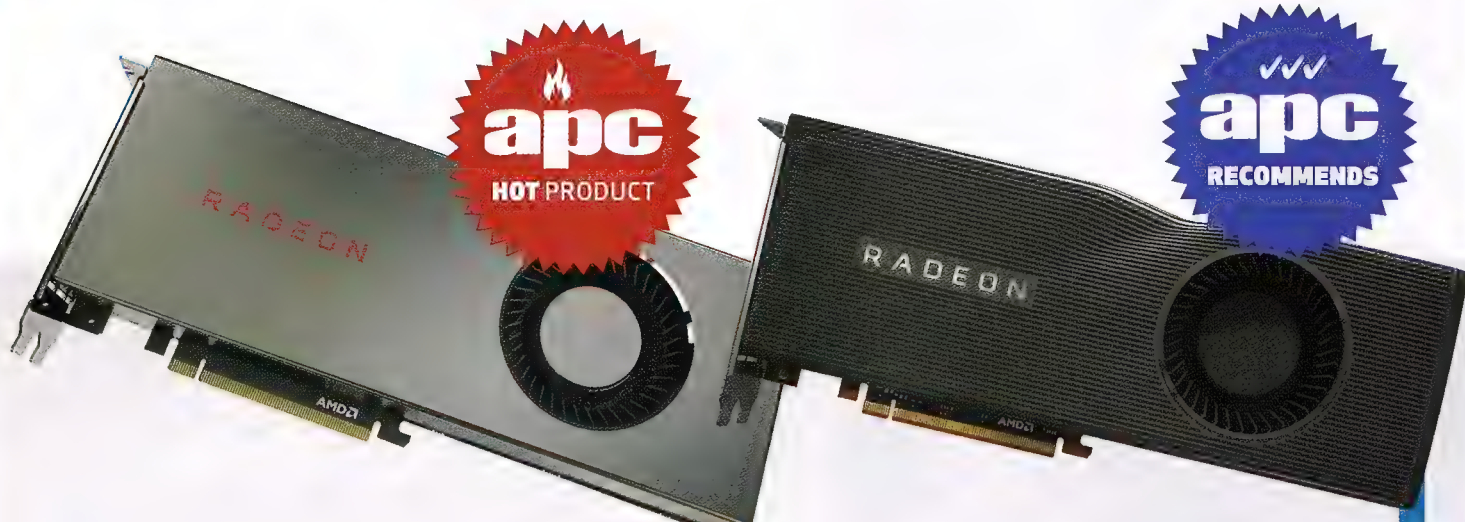


PERFORMANCE

	GHOST RECON WILDLANDS (VERY HIGH PRESET - AVG FPS)			METRO: EXODUS (ULTRA PRESET - AVG FPS)		
	1920X1080	2560X1440	3840X2160	1920X1080	2560X1440	3840X2160
NVIDIA GEFORCE GTX 1080 TI	113.8	88.4	54.8	72.8	57.3	36.0
NVIDIA GEFORCE GTX 1080	96.8	73.7	40.7	60.2	46.5	28.3
AMD RADEON VEGA 56	78.8	61.5	37.5	53.1	42.4	27.3
NVIDIA GEFORCE RTX 2060	90.8	68.3	39.6	55.9	43.3	26.4
NVIDIA GEFORCE RTX 2070	105.5	80.9	47.0	65.9	51.4	32.0
NVIDIA GEFORCE RTX 2080	116.3	89.7	54.3	80.8	63.2	39.9
AMD RADEON VII	102.1	81.9	51.5	70.2	57.2	37.3
NVIDIA GEFORCE RTX 2060 SUPER	102.6	78.6	45.5	63.5	49.5	30.7
NVIDIA GEFORCE RTX 2070 SUPER	107.1	83.8	51.5	73.1	57.0	35.7
AMD RADEON RX 5700	95.3	73.8	44.6	62.6	49.6	30.4
AMD RADEON RX 5700 XT	105.9	83.8	50.5	70.3	56.1	34.2

	SHADOW OF WAR (ULTRA PRESET - AVG FPS)			SHADOW OF THE TOMB RAIDER (HIGHEST - AVG FPS)		
	1920X1080	2560X1440	3840X2160	1920X1080	2560X1440	3840X2160
NVIDIA GEFORCE GTX 1080 TI	123	88	51	117	80	43
NVIDIA GEFORCE GTX 1080	99	68	40	95	64	33
AMD RADEON VEGA 56	94	64	38	89	61	31
NVIDIA GEFORCE RTX 2060	96	67	40	90	60	31
NVIDIA GEFORCE RTX 2070	116	82	50	107	73	38
NVIDIA GEFORCE RTX 2080	133	98	60	125	88	47
AMD RADEON VII	124	87	54	123	85	45
NVIDIA GEFORCE RTX 2060 SUPER	111	79	48	103	70	37
NVIDIA GEFORCE RTX 2070 SUPER	123	89	55	115	80	42
AMD RADEON RX 5700	99	67	40	102	68	35
AMD RADEON RX 5700 XT	116	77	45	115	77	39

	TEMPERATURES @		3DMARK		GEEKBENCH GPU COMPUTE SCORE
	IDLE	LOAD	TIME SPY	FSE	
NVIDIA GEFORCE GTX 1080 TI	37	79	9,464	13,055	209,240
NVIDIA GEFORCE GTX 1080	38	74	7,869	10,343	182,663
AMD RADEON VEGA 56	36	79	6,911	9,300	214,597
NVIDIA GEFORCE RTX 2060	36	68	7,827	8,899	222,767
NVIDIA GEFORCE RTX 2070	36	72	9,201	10,721	267,539
NVIDIA GEFORCE RTX 2080	37	72	10,864	12,700	295,913
AMD RADEON VII	39	78	8,914	12,252	233,124
NVIDIA GEFORCE RTX 2060 SUPER	37	72	8,936	10,296	252,528
NVIDIA GEFORCE RTX 2070 SUPER	35	70	9,936	11,554	273,974
AMD RADEON RX 5700	38	80	7,867	10,246	304,518
AMD RADEON RX 5700 XT	38	84	8,843	11,551	337,712



AMD Radeon RX 5700, 2304 Stream Processors, 1465MHz Base Clock, 1725MHz Boost Clock, 8GB GDDR6 14Gbps memory, 448GB/s Memory Bandwidth, 3x Display Port 1.4, 1x HDMI 2.0b, 1x 8-Pin, 1x 6-Pin Power Connector, 180W TDP.

AMD Radeon RX 5700 XT, 2560 Stream Processors, 1605MHz Base Clock, 1905MHz Boost Clock, 8GB GDDR6 14Gbps memory, 448GB/s Memory Bandwidth, 3x Display Port 1.4, 1x HDMI 2.0b, 1x 8-Pin, 1x 6-Pin Power Connector, 225W TDP.

\$549 | WWW.AMD.COM

\$629 | WWW.AMD.COM

AMD Radeon RX 5700

Reinvigorating the mid-range GPU marketplace.

The RX 5700 uses a slightly pared down version of the full Navi GPU found in the 5700 XT. It's not the first 7nm GPU (The Radeon VII takes that honour) but it is the first to use AMD's new RDNA architecture. Clearly AMD has done its job as Navi trounces Vega and AMD feels confident it can go head to head with Nvidia given the relative price increases over similar Polaris based RX 500 GPUs.

The RX 5700 makes use of a blower style cooler. We understand why AMD chose to go with this, but having experienced the Nvidia Founder's Edition cards, we feel that AMD's reference coolers are still too noisy and inefficient. The incoming partner cards should address this and turn the 5700 into the cool and quiet cards we want to see. It's got a 185W TDP which indicates AMD is trying to extract performance

rather than go for absolute power efficiency in an attempt to compete with Nvidia. And compete it does. It's an excellent choice of card to pair with a high refresh rate 1080p Freesync monitor.

The 5700 isn't too much slower than the RTX 2060 Super and with the pre-launch price drop, it's the one we'd choose of the two, but only from a price/performance point of view. AMD still can't catch Nvidia in the power efficiency stakes and it lacks some key technologies such as ray tracing support. If those things aren't important to you, then by all means the RX 5700 is a good value performer.

Verdict

The RX 5700 is good value but partner cards are worth waiting for.



AMD Radeon RX 5700 XT

Welcome competition.

The RX 5700 XT makes use of the full Navi GPU. Its 2,560 processors are clearly a massive efficiency step forward compared to the much higher shader count of the aging Vega architecture. The card makes use of a stylish blower style cooler, but again we feel it's a bit too loud for our liking and we'd rather wait for the partner cards which should be cooler and quieter.

The 5700 XT comes with a standard set of outputs, consisting of three DP 1.4 and a HDMI 2.0b port. Given how much AMD talked about its power efficiency gains, we wish it could have kept this card under 200W. It certainly would have helped keep temperatures under control as our sample went up to into the 80s at times.

Performance wise, the 5700 XT gets its nose in front of the 2060 Super and isn't that far behind the 2070 Super, which is

impressive as now it's significantly cheaper. If you've got a high end Freesync monitor, this is clearly the card to get.

Which card you go for may come down not to performance, but whether things like ray tracing are important to you. AMD has its nose in front at its price points, but still it feels too high for what are ostensibly mid-range GPUs. Navi is a strong start for AMD. If it can refine the architecture and perhaps bring the pricing back to levels more gamers will appreciate, then we're sure Navi can become a big success for AMD. But for Radeon, the 'Ryzen moment' isn't quite here yet.

Verdict

The 5700 XT has a lot of potential, but the reference card is hampered by its inefficient cooler.





Nvidia GeForce RTX 2060 Super, 2176 Cuda Cores, 1470MHz Base Clock, 1650MHz Boost Clock, 8GB GDDR6 14Gbps memory, 448GB/s Memory Bandwidth, 2x Display Port 1.4, 1x HDMI 2.0b, 1x DVI-D, 1x USB Type-C, 1x 8-Pin, 1x 6-Pin Power Connector, 175W TDP.

\$690 | WWW.NVIDIA.COM

Nvidia GeForce RTX 2060 Super

Entry level RTX just got better.

The RTX 2060 Super retains the TU106 GPU of the vanilla RTX 2060, but unlocks more of its cores and goes a long way to minimising the performance gap to the RTX 2070. Whereas the 2060 has 1920 Cuda cores, 240 Tensor cores and 30 RT cores, the Super increases these counts up to 2176, 272 and 34 respectively. Nvidia has also addressed one of the more visible shortcomings of the RTX 2060 by increasing the amount of VRAM on the Super to 8GB, instead of the original 6GB.

The 2060 Super is otherwise identical to the 2060. The cooler is still a strong point of the Founder's Edition we have for review. There's no noisy blower cooler here. The TDP of the card has taken a small jump from 160W to 175W, but thankfully this has next to no impact on the cooling capabilities of the

impressive FE cooler.

The RTX 2060 Super retains the 2060's display output configuration with two DP 1.4 connectors, a single HDMI 2.0b, Dual-link DVI and a Virtual Link Type-C USB port.

Nvidia has positioned the card very well as it keeps its nose in front of the RX 5700, but cannot beat the XT. Of course Navi doesn't have some of the key technologies like ray tracing and variable rate shading which add value.

The RTX 2060 is a welcome refresh of the 2060, but its weakness remains its high pricing. \$690 is going to deter a lot of gamers.

Verdict

The RTX 2060 Super is a tech packed, high performing card, but is under price pressure.



Nvidia GeForce RTX 2070, 2560 Cuda Cores, 1605MHz Base Clock, 1770MHz Boost Clock, 8GB GDDR6 14Gbps memory, 448GB/s Memory Bandwidth, 3x Display Port 1.4, 1x HDMI 2.0b, 1x DVI-D, 1x USB Type-C, 1x 8-Pin, 1x 6-Pin Power Connector, 215W TDP.

\$860 | WWW.NVIDIA.COM

Nvidia GeForce RTX 2070 Super

What the 2070 should have been from the start.

Given its name, you'd assume the RTX 2070 Super has a lot in common with its non-Super sibling, but actually it has a lot more in common with the RTX 2080. Where the RTX 2070 uses the TU106 GPU, the Super version comes with a lite version of the TU104 GPU as found in the RTX 2080. This means more Cuda, RT and Tensor cores (2,304, 26 and 288 for the 2070 vs 2,560, 40 and 320 for the 2070 Super).

As expected, the 2070 Super Founder's Edition we're testing here is physically the same as the RTX 2080 FE, though it comes with a nice mirror effect on the face. We were very impressed with the step forward that Nvidia made with the RTX FE coolers and we're sticking with that opinion here. In operation, the card remains quiet without compromising much on temperatures.

The RTX 2070 Super offers three DP 1.4 connectors, a single HDMI 2.0b, and a VirtualLink Type-C USB port.

The card performs very well. Finally it gets close to the performance of the GTX 1080 Ti while going a long way towards bridging the gap to the RTX 2080. More importantly, it sees off the potential challenge of the RX 5700 XT, where the vanilla 2070 would have been vulnerable.

The RTX 2070 Super should have been named the 2070 Ti, but whatever it's called, it's the best performing card and still the best featured card in this price range, which is admittedly, quite high at \$860.

Verdict

The 2070 Super sees off the 5700 XT but it remains a pricey proposition.





CPU

\$519 & \$780 | WWW.AMD.COM

AMD Ryzen 7 3700X and Ryzen 9 3900X

The real deal.

Back when first generation Ryzen CPUs launched, we lauded their newfound competitiveness, particularly under highly threaded workloads. Power efficiency was also strong, but it lacked that bit of single-threaded performance that kept Intel in the overall lead. 2nd generation Ryzen closed that gap, but only a tiny bit. Now we have 3rd generation Ryzen. It's just as important for AMD and the market as the first generation was. If the first generation was laying a foundation, then third generation is more like the culmination. Straight up, Ryzen 3 is the real deal and it brings AMD to a level of competitiveness

not seen since the Athlon 64 glory days.

We have to start by drawing attention to just how much of an engineering undertaking Ryzen 3 is. We'd be covering it if there was an architectural change, a process change or a fundamental shift to a chiplet design. Ryzen 3rd gen is all three of those things, with the added challenge of not even changing the socket. There's also the fact that PCIe 4.0 makes its PC debut. AMD really does deserve credit for accomplishing all that at the same time.

COMPETITION ACROSS THE RANGE

The Ryzen 3rd gen line-up debuts with the launch of the

mid to high end models first. The entry level CPUs for now are the 3600 and 3600X hex-core Ryzen 5 models. We'd expect budget quad core versions to follow later in the year. Based on spec alone, our pick of the bunch would be the Ryzen 7 3700X. It's an 8c/16t part that's notable for having a healthy 4.4GHz boot clock at a very impressive 65W TDP. The 3800X is a higher clocked eight core model with a 3.9GHz/4.5GHz boost with a 105W TDP.

Topping the range are the Ryzen 9 3900X and 3950X. These models pack 12 and 16 cores into a very respectable 105W TDP. Compare this to the likes of the 16 core Threadripper 2950X at 180W, along with Intel's

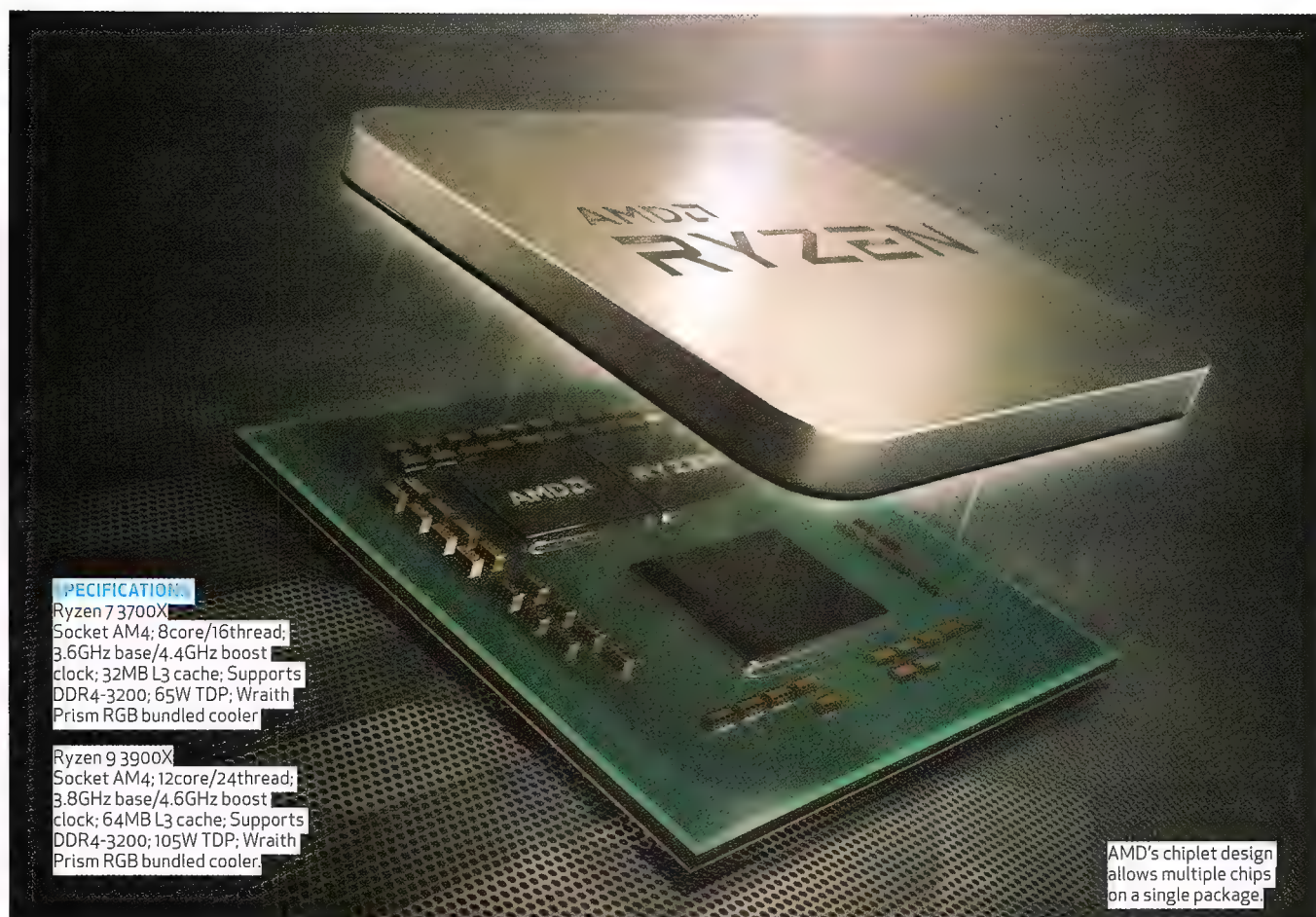
165W Kaby Lake-X models and it's clear that AMD's power efficiency has taken a massive step forward. It also means there isn't a requirement for powerful cooling. The 3900X is on sale now while the 3950X is expected to come on sale in September.

All Ryzen CPUs come with a bundled cooler. Our 3700X and 3900X samples come with the highest spec Wraith Prism RGB model. It's a capable cooler, though it won't be able to compete with the larger surface area air coolers or decent AiO's. It certainly looks good with an attractive splash of RGB lighting.

A MONUMENTAL ENGINEERING FEAT

Ryzen 3rd gen CPUs mark the debut of the Zen 2 architecture. The 'Matisse' desktop family we're covering here will be joined by the 'Rome' server CPU family (very exciting for AMD) as well as future Threadripper and likely APUs in the more distant future.

"Topping the range are the Ryzen 9 3900X and 3950X. These models pack 12 and 16 cores into a very respectable 105W TDP."



SPECIFICATION:

Ryzen 7 3700X
Socket AM4; 8core/16thread;
3.6GHz base/4.4GHz boost
clock; 32MB L3 cache; Supports
DDR4-3200; 65W TDP; Wraith
Prism RGB bundled cooler

Ryzen 9 3900X
Socket AM4; 12core/24thread;
3.8GHz base/4.6GHz boost
clock; 64MB L3 cache; Supports
DDR4-3200; 105W TDP; Wraith
Prism RGB bundled cooler.

AMD's chiplet design
allows multiple chips
on a single package.

As we mentioned in the intro, the engineering challenge Ryzen 3rd gen represents is enormous. Firstly there's the move to a chiplet based design. Ryzen 3rd gen CPUs contain three dies, consisting of two core complexes built with the 7nm process, and an I/O die built on 12nm. With that in mind, consider that all AM4 processors must adhere to the same pinout. AM4 has gone from supporting monolithic quad core 28nm CPUs to 7nm multi die sixteen core CPUs plus the shift to PCIe 4.0 while maintaining backwards compatibility. It's a real feat of engineering. Intel could certainly learn a thing or two from this.

Then there's the move to 7nm. This allowed AMD to really shrink transistor size and hence the core complexes (CCX). A single CCX is just 74 sq mm, with a big chunk of this being taken up by the L3 cache. These small chiplets means AMD benefits from improved wafer density and lower

"AM4 has gone from supporting monolithic quad core 28nm CPUs to 7nm multi die sixteen core CPUs plus the shift to PCIe 4.0 while maintaining backwards compatibility."

costs while gaining increased design flexibility and scalability.

Then there's the architecture itself. Perhaps the biggest architectural gain comes from a redesigned cache hierarchy. A larger micro-op cache, 512k L2 cache and a doubling of the L3 cache to 32Mb per die all add up to a big chunk of the latency improvements between Ryzen 2nd and 3rd generations, which particularly helps to increase game performance.

Additionally there's an all new TAGE branch predictor, doubled floating point capability, which all put together leads AMD to claim that IPC has been uplifted by up to an impressive 15%, and that's before taking into

account any clock speed improvements.

Additional improvements include higher memory clock support thanks in part to a new memory clock/infinity fabric divider, security vulnerability hardening and on the software side, Windows scheduler

improvements with the May 10th 1903 update.

MOVING ONTO THE NUMBERS

So, how do these things perform? The answer: very well! It's clear that AMD has taken a significant step forward. When comparing



the » AMD Ryzen 7 3700X and Ryzen 9

AMD RYZEN 7 3700X AND RYZEN 9 3900X BENCHMARK RESULTS

	CINEGY CINESCORE VIDEO ENCODING	CINEBENCH 20	CINEBENCH 20	7ZIP	CPUZ
	AVC 400 ULTRA 2160P FPS	MULTI THREAD SCORE	SINGLE THREAD SCORE	MILLION INSTRUCTION PER SECOND	SINGLE AND MULTI THREADED SCORE
INTEL CORE I7-8700K	52	3478	496	40,562	524.3, 3853.7
INTEL CORE I9-9900K	69	4987	510	54,330	564.9, 5496.0
AMD RYZEN 2 2700X	61	4014	437	45,649	480.7, 5013.0
AMD RYZEN 2 2600X	50	3058	428	37,228	471.1, 3718.6
AMD RYZEN 7 3700X	68	4820	501	57,532	527.5, 5576.3
AMD RYZEN 9 3900X	93	7163	520	82,560	548.3, 8327.6

	BLENDER 2.79 BMW RENDER	TIME SPY PHYSICS	MIDDLE EARTH: SHADOW OF WAR	GHOST RECON: WILDLANDS	COUNTER-STRIKE: GLOBAL OFFENSIVE
	TIME (SECONDS) LOWER IS BETTER	SCORE	1080P, LOW, DX12, AVG FPS	1080P, LOW, AVG FPS	1440P MAX SETTINGS, AVG FPS
INTEL CORE I7-8700K	311.44	7911	215	177.4	319.4
INTEL CORE I9-9900K	219.14	11080	220	180.8	337.1
AMD RYZEN 2 2700X	264.41	8874	183	167.2	295.3
AMD RYZEN 2 2600X	360.49	6494	179	158.7	286.7
AMD RYZEN 7 3700X	233.71	9940	203	174.0	326.0
AMD RYZEN 9 3900X	156.83	12154	211	176.3	333.9

	SYSTEM IDLE POWER (W)	SYSTEM LOAD POWER (W)
INTEL CORE I7-8700K	53.2	180.7
INTEL CORE I9-9900K	74.4	272.5
AMD RYZEN 7 3700X	74.4	149.8
AMD RYZEN 9 3900X	84.3	204.1

the similarly priced 3900X and 9900K. AMD clearly has the advantage under heavily threaded loads with its 8 vs 12 cores. It also eats almost all of Intel's single thread lead as well as its gaming advantage. At this point it's important to note that when the load shifts back to the GPU with higher graphics settings, the difference between all the top performing processors essentially evaporates.

While multithreaded performance is outstanding, AMD hasn't quite reached performance parity with Intel overall. Lightly threaded performance still matters and if you're a gamer, Intel has its nose in front there largely thanks to its high clocks, but not necessarily at every price point. If you're a content

creator or someone who can make use of the multi-threaded power, then AMD is the best choice right now.

Don't forget the flagship 3950X. As the highest clocking processor with the most cores, it's likely that the best is yet to come.

TEMPERATURES AND POWER CONSUMPTION

We used the bundled Wraith Prism RGB which performed surprisingly well. Our 3900X got a bit toasty under sustained all core load but maxed out at 80c which is acceptable. The 3700X fared better and never hit 75c.

Power consumption figures are amazing under load, with both the 3700X and 3900X taking an efficiency lead despite handicap of their extra cores. Idle power was a bit

higher than we'd like but we were using beta pre-release BIOS so we'd expect those numbers to improve over time.

COMPELLING, VERY COMPELLING

Zen 2 takes all the things we liked about Zen and Zen+ and makes them better. Multithreaded performance has gone from very good to excellent. Single threaded performance has taken a big jump forwards and AMD's gaming performance is as competitive as it's been since the Athlon 64 days.

It's easy to make the argument that AMD has pulled alongside Intel in outright performance. Consider that the 3900X goes close enough to matching the mighty 9900K in single threaded performance whilst offering more cores and hence significantly better multi-threaded performance, all while using less power.

The Ryzen 7 3700X is a wonderful processor. Its

power thrifty, runs cool, has mega multithreaded prowess combined with single threaded performance that brings it to within touching distance of Intel's higher clocked parts. It's a really good all-rounder.

The 3900X is just as praiseworthy. If you need the multi-threaded grunt then for sure it's a terrific purchase compared to the likes of AMD's own Threadripper platform and Intel's 12 core \$1,750 i9 9920X. In that light, the \$780 3900X is an absolute steal.

AMD was competitive with Ryzen and Ryzen 2nd gen, but with Ryzen 3rd gen it's come back to a state of near performance parity. The CPU wars are back in full swing. Intel might hold onto the single threaded and gaming crown, but its lead has shrunk dramatically. Competition is good for everyone. Over to you Intel.

Chris Szewczyk

Verdict

The new Ryzen CPUs offer terrific value and go oh so close to winning in every performance measurement.

3700X



3900X



"Power consumption figures are amazing under load, with both the 3700X and 3900X taking an efficiency lead despite handicap of their extra cores."



AMD X570 motherboards

AMD means budget? No way! Chris Szewczyk says hello to perhaps the most feature-packed desktop motherboards ever.

If you've made the decision to build a new system around a Ryzen 3rd gen CPU, you could go with an existing chipset thanks to backwards compatibility, or you could jump up to what are clearly some of the most advanced and feature packed motherboards ever created. PCI Express 4.0 might be the headline grabbing feature, but that's far from all X570 boards bring to the table. This is a platform that's premium in pretty much every way and many of these new boards come with features that not even the most expensive HEDT boards can match, with the exception of their high PCIe lane counts.

The headline grabbing motherboard feature is support for PCI Express 4.0.

While it might be logical to conclude that this will benefit graphics cards the most, single GPUs stand to benefit very little, at least in the short term as PCIe 3.0 x16 isn't a bottleneck. There is evidence to suggest that high-end SLI and Crossfire is beginning to hit a bottleneck at PCIe 3.0 x8. So beyond the short term, PCIe 4.0 will benefit multi GPU setups, though for now, PCIe 3.0 is enough to feed even the likes of an RTX 2080 Ti.

TICKING ALL THE BOXES

The higher tier X570 motherboards definitely come with exciting feature sets. Networking in particular has taken a major step forward. Wi-Fi 6 (802.11ax) makes its widespread debut. 2.5, 5 and 10G LAN are also

becoming more common. We're personally thrilled that faster than Gigabit LAN is slowly becoming mainstream. Gigabit is one of those technologies that should have been superseded a decade ago. Add in things like tons of USB ports including native USB 3.2 Gen 2, stronger VRM solutions with cooling that's actually effective and not just aesthetic and of course PCIe 4.0 connectivity, and you can see where some of the extra cost comes from. It's terrific to have the option to buy premium HEDT level boards for a 'mainstream' CPU socket. Though you will certainly have to pay for it!

On the topic of pricing, with all these new features, some of the motherboard pricing is rather outrageous. Gigabyte and MSI have models costing well over \$1,000. At Computex, Asrock showed off its X570 Aqua at US\$999! Do the conversion... While Asus doesn't yet, we can imagine it won't take too long for it to have a \$1,000 board too. Having said that, there are X570 boards on sale that cost under \$300 AUD. While X570 will never be considered cheap, at least there are relatively affordable options for

"We're personally thrilled that faster than Gigabit LAN is slowly becoming mainstream. Gigabit is one of those technologies that should have been superseded a decade ago."



buyers who would never even consider a \$1,000 motherboard. It's also important to note that X470 will not be phased out, with ongoing support and production set to continue for the foreseeable future. Many B450 boards are also receiving ongoing BIOS updates, though we'd be wary of running the higher core count CPUs on boards that have relatively weak power delivery systems and cooling.

THE FASTEST STORAGE SOLUTION

PCIe 4.0 M.2 drives provide the most visible performance gains. There are already PCIe 4.0 drives on the market and these are the fastest consumer level drives on the market right now, at least in terms of sequential read and write performance.

The real benefit of PCIe 4.0 is the flexibility it offers motherboard manufacturers when it comes to designing the I/O. All of the auxiliary controllers are connected to the CPU or chipset via PCIe lanes. As PCIe 4.0 doubles the bandwidth of PCIe 3.0, this means a single PCIe 4.0 lane can do the job of dual PCIe 3.0 lanes. This allows for some creatively designed and equipped motherboards. 10G LAN? Extra SATA? More USB 3.2 ports? All of these things can be relatively easily added to an X570 motherboard compared to the likes of a PCIe 3.0 lane limited Z390 board.

The X570 platform keeps the familiar dual channel memory configuration, but supports a faster official memory speed of up to

"Some boards are quieter than others, while others see their fan temporarily shriek like a banshee upon bootup."

DDR4-3200. First generation Ryzen suffered from poor memory speed support. This has been addressed with Ryzen 3 and X570 motherboards with the addition of an Infinity Fabric divider, which removes a bottleneck that held back faster memory support. Memory at around DDR4-3600 or little higher is proving to be the sweet spot for performance. Beyond this, the memory clock to Infinity Fabric divider drops to 2:1, adding a latency penalty.

A BIT HOT UNDER THE COLLAR

You may have noticed that almost all X570 motherboards have a chipset cooling fan. There are two main reasons for this, depending on the particular board. The first reason is because the chipset draws up to 11W of power compared to around 6W for X470. This is primarily due to PCIe 4.0 power requirements. A second reason is that many motherboard manufacturers are incorporating M.2 drive cooling into the chipset heat sink, something we're not keen on for cooling and convenience reasons.

Sometimes almost the whole bottom of the board is a giant heat sink cooling multiple hot M.2 drives plus

the 11W PCH. That explains the fan. The good news is that most manufacturers will configure their boards in such a way that the fans won't spin up until they hit a certain temperature threshold. Some boards are quieter than others, while others see their fan temporarily shriek like a banshee upon bootup. BIOS updates have already appeared to improve this. In general use, the chipset fans remain either silent or unobtrusive. Beware though, tiny fans are extremely annoying when they do spin up, so a custom BIOS fan profile could be well worth it.

The performance of Ryzen 3rd-gen is seriously impressive. When combined with the features on offer from the feature rich X570 platform, AMD deserves serious consideration from every kind of PC user. It's time to take a closer look at four impressive motherboards from Asrock, Asus, Gigabyte and MSI.

These boards represent the high end, but not the seriously top end boards, which are, frankly, irrelevant to the majority of the market. Read on as we look at arguably the most feature rich desktop motherboards ever seen.



Asrock X570 Taichi; Socket AM4; Support for AMD Ryzen 2nd & 3rd Gen processors; 3x M.2; 8x SATA; 2x USB 3.2 Gen 2, 10x USB 3.1 Gen 1, 4x USB 2.0; 802.11ax 2.4Gbps Wi-Fi; 1x HDMI; Intel I211AT Gigabit LAN; Realtek ALC1220 7.1 Channel High Definition Audio; ATX Form Factor.

\$499 | WWW.ASROCK.COM

Asrock X570 Taichi

Asrock strives to find its inner zen.

Asrock's Taichi brand stands out as a competitive option that doesn't scream gaming. Taichi boards usually offer an excellent combination of useful features and affordable price. Can the X570 Taichi keep its value reputation intact with X570 pricing moving upwards?

The X570 Taichi has taken a step up in looks from the X470 Taichi. It really is lovely looking with the chipset heatsink's gears and cogs being a nice retro analogue artistic touch. Of course there are healthy splashes of RGB around the heatsink as well as above the I/O cover and the right hand side of the board. Like the other X570 boards in the test, the VRM and cooling assembly have taken a step forward to cope with the demands of

powering the likes of the Ryzen 9 3950X 16-core monster.

Asrock has included 8 pin and 4 pin CPU power connectors mated to a high spec 14 phase power delivery system. There won't be any worries powering a 16 core Ryzen CPUs on this board. You get eight SATA connectors and three M.2 slots. The three M.2 heat sinks are incorporated into the chipset heat sink which extends to almost the entire bottom half of the board. It's necessary to remove the entire covering section to install the M.2 drives. It's fiddly and inconvenient. We'd rather see the drive manufacturers consistently incorporate heat sinks instead of the kind of solution the Taichi offers.

The Taichi is the only board in the roundup to

include a HDMI port. This makes it suitable for use with a Ryzen APU. Obviously not too many users are going to buy a \$500 motherboard to pair with a \$200 APU, but it's nice to have the option for IGP. What if AMD release something like a 6-core Navi equipped APU in the future? That's something that could be seriously attractive.

The rest of the I/O is average. There's only two USB 3.2 Gen 2 ports (one type-A and one Type-C) which is a little lacking compared to some of the other boards in the test. These are joined by six Gen 1 ports. The Taichi is also the only board in the test that doesn't include 2.5G LAN. It does come with Wi-Fi 6 as we'd expect at this price, but still, 2.5G would have been nice.

The Taichi performed well

in CPU and memory based tests. We used the latest BIOS which appears to have boosted CPU performance a little over the beta BIOS we first tested with. It also fixes what was very annoying chipset fan speed and noise.

Asrock's Taichi boards usually impress us, but the X570 example doesn't quite excite us like previous Taichi boards. It's not bad at all but it lacks a couple of key features that we'd expect from Asrock at this price, and we aren't fans of the fiddly M.2 installation. If it were a bit cheaper then we'd be more receptive. Still, if you're going to stick to Wi-Fi and don't care about having heaps of ultra-fast USB, then the savings over the higher end gaming boards makes the X570 Taichi worthy of consideration.

"It's not bad at all but it lacks a couple of key features that we'd expect from Asrock at this price."

Verdict

Perhaps previous Taichi's spoiled us. At this price we'd like to see just a little bit more.





Asus ROG Crosshair VIII Hero Wi-Fi; Socket AM4; Support for AMD Ryzen 2nd & 3rd Gen processors; 2x M.2; 8x SATA; Up to 9x USB 3.2 Gen 2, 6x USB 3.1 Gen 1, 4x USB 2.0; 802.11ax 2.4Gbps Wi-Fi; Intel I211AT 1G and Realtek RTL8125-CG 2.5G LAN; Realtek ALC1220 7.1 Channel High Definition Audio; ATX Form Factor.

\$649 | WWW.ASUS.COM

Asus ROG Crosshair VIII Hero Wi-Fi

A lot of motherboard, but also a lot of dollars.

In years past, a ROG Hero board would have been positioned as one of the value ROG offerings. The fact that this is a \$649 board goes to show how expensive X570 models can really be. Perhaps we'll see an even more expensive Crosshair Extreme or Apex board down the line?

You'd expect such a board to have a comprehensive feature list, and it does. 8 pin and 4 pin power connectors feed a 16 phase VRM, with each MOSFET being rated to handle 60 amps. Overclockers wanting to shove hundreds of watts through the CPU won't face any issue here, though all the boards shown here also have strong VRM solutions. The Crosshair VII Hero had beefy heat sinks but those on the VIII have even more surface area to cope with the power demands of an

overclocked processor. The RGB implementation is fairly subtle with just the chipset and I/O area being illuminated.

The ROG Hero is the only board in the test that has only two M.2 slots.

There's an isolated heat sink for a single drive (the other slot requires removing part of the chipset heat sink assembly). You'll also see eight SATA ports for the file hoarders out there. Overall it's an attractive and functional layout.

The I/O area has an integrated shield and is chock full ports. Asus has equipped the Hero with no less than 12 USB ports on the back panel alone with more possible via internal headers. Eight are USB 3.2 Gen 2 ports, far more than any other board in the roundup. There's also four Gen 1 ports. Wi-Fi 6 is set to become standard at this end of the market and we're

pleased to see the inclusion of Intel Gigabit and Realtek 2.5G LAN ports too. Networking has taken a major and welcome step forward on X570.

Asus' ROG UEFI BIOS remains as comprehensive as ever. Users familiar with Asus BIOS will be right at home, however it can be a bit overwhelming at times for inexperienced users. It's packed full of options, with a million things to play around with.

We expect nothing less than excellent performance from every ROG board we test, and the Asus shows itself well. We used the Hero for our Ryzen CPU review and subsequently installed the latest available AGESA 1.0.0.3 BIOS for this test. We got a small performance uplift in CPU benchmarks. The gain was just a percentage point or two here and there, within the margin of error really, but free performance

is always welcome. The other boards also had the latest available BIOS installed.

We came away impressed with the Crosshair VII Hero. If you're a long time ROG fan, you won't be disappointed. It's got everything you'd expect to see included in a 'mid-tier' ROG board. It's still a pricey proposition though and that's its only real weakness in the face of the more affordable, yet similarly spec'd and refined options from MSI and Gigabyte.

Verdict

Asus' Crosshair VIII Hero is a capable and well equipped offering but it faces tough price competition.





Gigabyte X570 Aorus Master; Socket AM4; Support for AMD Ryzen 2nd & 3rd Gen processors; 3x M.2; 8x SATA; Up to 5x USB 3.2 Gen 2, 6x USB 3.1 Gen 1, 8x USB 2.0; 802.11ax 2.4Gbps Wi-Fi; 1x HDMI; Intel I211AT 1G and Realtek 2.5G LAN Realtek ALC1220 7.1 Channel High Definition Audio; ATX Form Factor.

\$629 | WWW.AORUS.COM

Gigabyte X570 Aorus Master

Impressive attention to detail.

Gigabyte's gaming products are now well established under its premium Aorus gaming brand. The X570 Aorus Master we're reviewing here is a reasonably priced fully featured offering at \$629 (strictly relatively!). It has many of the Aorus traits we've come to expect are here including a lovely RGB look and a well-engineered audio implementation.

One of the things we really like about the Aorus Master is the use of proper finned VRM heat sinks. This greatly increases the cooling surface area, and Gigabyte has managed to combine functionality with aesthetics. Long may this continue!

Gigabyte have included three M.2 slots, each with their own isolated cooling unlike many other boards which have a fiddly

installation procedure. The heat sinks can be removed making it suitable for use with the increasingly prevalent heat sink equipped M.2 drives, particularly PCIe 4.0 ones including Aorus own PCIe 4.0 drive with its chunky copper design.

Gigabyte has completely overhauled the VRM compared to the X470 Master. A genuine 14 phase VRM with dual 8 pin auxiliary power connectors is capable of delivering 700 amps according to Gigabyte. Need 1,000W for your CPU? No worries!

We're usually impressed with the attention to detail that Gigabyte pays towards its audio solutions and the Aorus Master continues this trend. The inclusion of an ESS Sabre DAC and things like WIMA capacitors mean that analogue audio performance is as good as any motherboard.

The I/O area has a good helping of ports with four USB 3.2 Gen 2, 2x Gen 1 and four USB 2.0. Additionally there's the Intel Gigabit and Realtek 2.5G LAN ports, which along with the 802.11ax Wi-Fi is standard on all but the cheaper Asrock board. 2.5G and higher is a very welcome addition to X570 boards.

The Aorus Master performed reasonably well in our benchmark test suite. It was perhaps marginally slower in single threaded applications but nothing to really take issue with. We'd expect boards that are part of a mature platform ecosystem to perform within one or two percent of each other at most, but with BIOS updates coming every other day on a new platform, you get the feeling there's some performance still to come.

The Aorus' UEFI BIOS is simple and easy to use, with

all the important features well laid out. It's probably not as comprehensive as the likes of the Asus BIOS, but it's easier to navigate and a touch more user friendly.

The X570 Aorus Master can never be called cheap at \$629 and on paper it's specification doesn't seem all that different from the likes of the Asrock Taichi or MSI Ace, but it's the little things and specific implementations that make a difference. The cooling is top notch along with the audio, as well as thoughtful M.2 cooling and good helping of I/O connectivity. Whether these things are worth the extra dollars over the cheaper MSI and much cheaper Asrock is up to you. We think the Gigabyte is relatively good value for what it offers.

"Gigabyte has completely overhauled the VRM compared to the X470 Master."

Verdict

The Aorus X570 Master's attention to detail is noteworthy, but still, \$629 is a lot to pay for motherboard.





MSI X570 Ace; Socket AM4; Support for AMD Ryzen 2nd & 3rd Gen processors; 3x M.2; 4x SATA; Up to 5x USB 3.2 Gen 2, 6x USB 3.1 Gen 1, 6x USB 2.0; 802.11ax 2.4Gbps Wi-Fi; Intel I211AT 1G and Realtek 2.5G LAN; Realtek ALC1220 7.1 Channel High Definition Audio; ATX Form Factor.

\$589 | WWW.MSI.COM

MSI X570 Ace

Has MSI aced it?

You can always count on MSI to deliver the strongest gaming message, but that doesn't tell the whole story as its engineering and quality control have come a long way in the last several years. The X570 Ace looks every bit a seriously high end product. It's one that caught our eye when we first saw it on display at Computex. It offers good value too at \$589.

The X570 Ace is a great looking board with its infinity effect RGB mirror combined with its black and gold theme. The M.2 slots are separate from the PCH cooler which makes drive installation a breeze. The MSI is the only board in the test to feature a heat pipe, which links the VRM cooling to the fan cooled PCH. This makes a lot of sense and should help to keep the board cool in different cases with different fan placements.

The VRM itself is very strong, as is the case with all the high end X570

"It's affordable (relatively) performs well and has the key features of the more expensive boards."

boards. 14 phases paired with 14 60A MOSFETs mean that power delivery won't ever be a problem. There's dual 8-pin power connectors too. The board only has four SATA ports, which is something to note if you need more. The I/O area has a good helping of ports with four USB 3.2 Gen 2, 2x Gen 1 and two USB 2.0. Like the more expensive Asus and Aorus, the MSI includes the very welcome Intel Gigabit and Realtek 2.5GB LAN ports plus 802.11ax Wi-Fi. Thank you!

The MSI OC dial at the bottom right of the board makes a return. We tried it but were instantly concerned with high temperatures and voltage, even at the lowest setting. Given that Ryzen 3000 series overhead appears to be limited, we'd advise users to OC themselves, at

least until the kinks in the platform are worked out.

The Ace performs well as we'd expect. AMD's updated AGESA BIOS microcode appears to have brought the boards together in terms of performance. All the boards are within one or two percent for the most part, or within the margin of error.

The MSI UEFI BIOS implementation has not changed much in recent years and remains one of the easier to navigate with its logically laid out designs. MSI's Fan control system and functionality is very good and you may wish to visit this to play with the PCH fan setting. Luckily with the latest available update the chipset fan remained quiet at all times and in fact doesn't spin up at all

under light use.

MSI's X570 Ace ticks all the boxes. It's affordable (relatively) performs well and has the key features of the more expensive boards in the roundup. The MSI and Aorus boards are quite close to each other in spec. The Gigabyte has a few little things we like whereas the MSI offers better value. Combine this with good looks and a typically easy to use BIOS and we think MSI has a board worthy of recommendation.

Verdict

MSI's X570 Ace offers great value for its feature set. It's a well refined package overall.



PERFORMANCE TESTING

	CINEGY CINESCORE VIDEO ENCODING	CINEBENCH R20	CINEBENCH R20
	AVC 400 ULTRA 2160P FPS	MULTI THREAD SCORE	SINGLE THREAD SCORE
INTEL CORE I7-8700K	52	3478	496
INTEL CORE I9-9900K	69	4987	510
AMD RYZEN 7 3700X	68	4820	501
GIGABYTE X570 AORUS MASTER	92	7209	519
ASROCK X570 TAICHI	92	7250	526
MSI X570 ACE	93	7247	525
ASUS ROG CROSSHAIR VIII HERO WI-FI	93	7278	528
	7ZIP	CPUZ	CPUZ
	MILLION INSTRUCTION PER SECOND	SINGLE SCORE	MULTI THREADED SCORE
INTEL CORE I7-8700K	40,562	524.3	3853.7
INTEL CORE I9-9900K	54,330	564.9	5496.0
AMD RYZEN 7 3700X	57,532	527.5	5576.3
GIGABYTE X570 AORUS MASTER	82,864	548.0	8353.9
ASROCK X570 TAICHI	82,732	553.7	8437.8
MSI X570 ACE	82,837	549.9	8370.8
ASUS ROG CROSSHAIR VIII HERO WI-FI	83,318	553.5	8402.0

'The performance of Ryzen 3 is seriously impressive. When combined with the features on offer from the feature rich X570 platform, AMD deserves serious consideration from every kind of PC user.'

	BLENDER 2.79 BMW RENDER	TIME SPY PHYSICS	MIDDLE EARTH: SHADOW OF WAR
	TIME (SECONDS) LOWER IS BETTER	SCORE	1080P, LOW, DX12, AVG FPS
INTEL CORE I7-8700K	311.44	7911	215
INTEL CORE I9-9900K	215.14	11,080	220
AMD RYZEN 7 3700X	233.71	9,940	203
GIGABYTE X570 AORUS MASTER	156.64	12,095	211
ASROCK X570 TAICHI	155.78	12,150	210
MSI X570 ACE	157.33	12,130	210
ASUS ROG CROSSHAIR VIII HERO WI-FI	156.13	12,123	211
	GHOST RECON: WILDLANDS	COUNTER-STRIKE: GLOBAL OFFENSIVE	
	1080P, LOW, AVG FPS	1440P MAX SETTINGS, AVG FPS	
INTEL CORE I7-8700K	179.4	319.4	
INTEL CORE I9-9900K	182.2	339.1	
AMD RYZEN 7 3700X	171.1	324.0	
GIGABYTE X570 AORUS MASTER	176.4	327.7	
ASROCK X570 TAICHI	175.8	327.7	
MSI X570 ACE	175.2	327.6	
ASUS ROG CROSSHAIR VIII HERO WI-FI	176.3	329.5	

CPU: AMD Ryzen 9 3900X; **Graphics:** Nvidia GTX 1080 Ti Founders Edition; **RAM:** 2x8GB G.Skill Trident-Z Royal DDR4-3600 C16; **Power Supply:** Antec HCP-1200W; **Storage:** 1Tb Samsung 970 EVO M.2 SSD; **Cooling:** Corsair H100i Pro; **Operating system:** Windows 10 Pro 1903 64-bit



ASUS X570 Buyer's Guide

PICKING THE RIGHT X570 MOTHERBOARD FOR YOUR NEXT PC.

The next generation of AMD Ryzen CPUs is here, pairing Zen 2 architecture with PCI Express 4.0 connectivity across multiple models that are based on the ASUS X570 chipset. This is the first desktop chipset to give you PCI Express 4.0 connectivity, granting you greatly expanded throughput – an extraordinary 2GB per lane! These motherboards are designed for the future – you'll be prepared for any SSDs, graphics cards, and other peripherals you might want to plug into down the track. Here's our rundown of ASUS' X570 range.

THE REPUBLIC OF GAMERS CROSSHAIR SERIES

The Crosshair VIII boards are designed for the serious overclocker and the gamer who wants to eek every bit of power from their system. These boards will push your PC to the next level, and future-proof it for years to come.

The Crosshair VIII Formula sports an integrated VRM water-cooling solution with its CrossChill EK III hybrid water channel, as well as active chipset and M.2 aluminium heatsinks to keep it cool as it goes to work. With a huge VRM, 16 PowIRstages and MicroFine Alloy chokes, this is a board designed to push the CPU as hard as it will

ROG Crosshair VIII comes with WiFi6 and 2.5Gb LAN.



Asus' Prime series boards are focused on work – but they can still play!



go, while remaining stable with a constant flow of power. The unit hosts a 1.3 inch OLED display for information on CPU speed, BIOS flashback status, and more, and the integrated Intel Wi-Fi 6 adapter and Aquantia 5G controller allow for superior connections and significant throughput. This is the top of the range board for serious builds, supporting 4x DDR4 memory, as well as two SLI plus three CrossFireX GPUs.

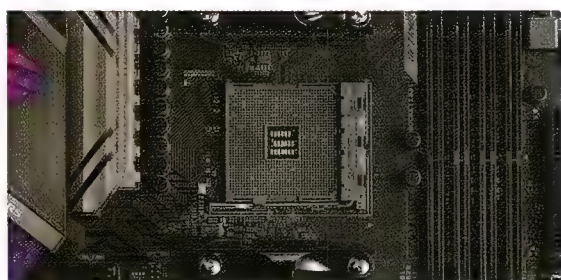
The Crosshair VIII Hero is equally powerful but is designed with air-cooled systems in mind. It's the same size and has many of the same incredible features, and just as much memory capacity. You can use the Hero without losing any power, so it's still ideal for overclocking. It features a light-up display for troubleshooting, and features connectors for AIO and custom loop pumps if you want to outfit your own cooling solution. There's a 2.5G LAN chip in place of the Aquantia if you're going for a pure ethernet connection.

The Crosshair VIII Impact is a mini-ITX two-DIMM board that allows for extreme overclocking in a smaller package. The 1DPC design enables superior DRAM OC headroom alongside the latest OptiMEM III Technology. It has many of the same features of the other Crossfire boards, including PCIe 4.0 lanes, Wi-Fi 6 networking, and Pre-mounted I/O shield. Metal backplate, SODIMM.2 and ESS® SABRE9023P headphone DAC are also in place to ensure zero compensation on expansion even after going small.

THE ROG STRIX SERIES

The Strix series is designed for complicated, interesting builds, and while it doesn't push quite as hard as the Crosshair series, it still has many of the same strengths and features. ROG has focused on giving gamers features they'll use.

The Strix X570-E Gaming and Strix X570-F Gaming are the headliners of this range, and they're both designed to be stunning to look at, but also extremely powerful and flexible. The E has a slight edge over the F when it comes to overclocking: its Digi+ VRM has 12+4 power stages, while the F has 12+2. Both feature superior copper heatpipes for improved dissipation, as well as OptiMem, a technology that focuses on improved stability and performance when you're tweaking RAM, a vital tool for tapping into your



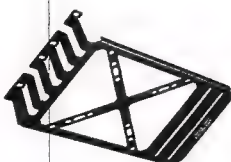
computer's full potential. They're built for fan or liquid cooling, depending on your set-up. Both boards feature 4 x DDR4 memory and HDMI 2.0 support. The F is designed with ethernet connections in mind, while the E is Wi-Fi 6 compatible and gives you the option of Bluetooth 5 support. Both use the powerful SupremeFX S1220A codec with double Amp, too.

The Strix X570-I Gaming is a Mini-ITX board that packs a lot of the same punch into a smaller form. It's got an extremely powerful VRM with 8+2 power stages – much more than you'd usually get in a mobo this size. It slots in under its own fan and features a metal backplate for superior cooling, which lets you push it hard for some serious overclocking. It features 2 x DDR4 memory, along with built-in HDMI 2.0 and DisplayPort 1.4 outputs, Intel Wi-Fi 6 and optional Bluetooth 5.0 support, making it ideal for a home cinema set-up. Finally, CROSSHAIR VIII and ROG STRIX X570 series come with USB BIOS Flashback for the absolute peace of mind when it comes to BIOS updates.

TUF GAMING

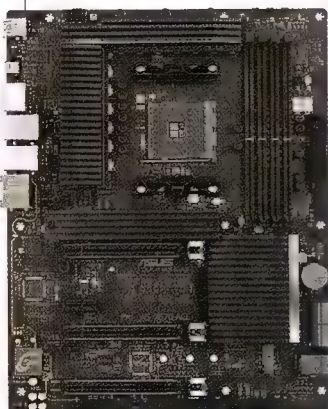
The TUF gaming range is designed to deliver the gaming features you need at a price you can afford, all in a board that you can rely on to get the job done. The TUF GAMING X570-PLUS (Wi-Fi) fits the bill. Its VRM uses 12+2 DrMOS power stages. It

The ROG range is focused on performance, while the TUF range delivers value and reliability.



This VGA holder can secure your graphics card.

Excellent power delivery sub-systems make for a smooth overclocking experience.



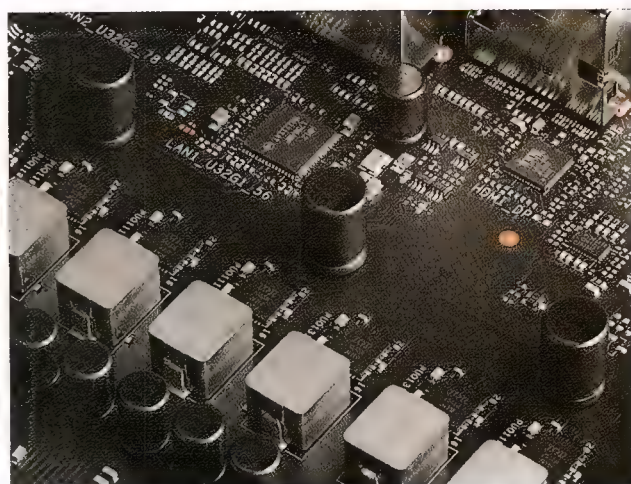
sports a high heat tolerance and TUF chokes to ensure steady power is being fed to the CPU. The ethernet port even features TUF LANGuard to protect against any potential hazards it might face. This is a board that you can depend on, with its PCIe x16 slots featuring SafeSlot reinforcement to improve retention and increase resistance to shearing.

THE PRO AND PRIME SERIES

Sometimes you want a system with some flexibility that won't look out of place in the office. The Pro WS X570-ACE pairs the X570 chipset's features with ECC RAM, Dash remote management network, plus expansions to server grade parts such

as enterprise NVMe and more. It's for when you need power beyond gaming – it's ideal for creators who need some serious power.

The Prime series' X570-PRO and X570-P are aimed at businesses, freelancers, and anyone who wants a versatile, powerful business PC. They can still handle a heavy gaming load, but their aesthetic and sensibilities are different. The Pro is more feature-rich, but the P will still deliver the goods. Last and not the least, all ASUS X570 motherboards come with custom made high performance PCH fan from Delta, for extended performance and longevity. Serving your system with confidence. ■





Memory buyer's guide

Chris Szewczyk takes a look at a range of DDR4-3200 memory kits and breaks down the things to look out for when shopping for a new kit.

When you're building a new PC, sometimes the memory can be almost an afterthought. Many buyers don't look beyond three key parameters: capacity, speed and price. These are obviously important, but there's more to it than that. Read on as we take a deeper look at some of the things you need to keep in mind when purchasing that shiny new kit of RAM. We've also got a roundup of kits from the biggest names in the market.

HOW MUCH RAM DO YOU REALLY NEED?

This is an age old question frequently found on tech forums. As DRAM prices

continue to fall in 2019, 16GB is becoming the standard amount being equipped in new systems. Laptops or lower end systems will be fine with 8GB for the most part if you're not doing anything too demanding. If you're using your PC for everyday tasks and gaming, 16GB is fine, but if you're one to have browser open with lots of tabs, productivity apps etc, and game all at the same time, and alt-tab between them, then you might want to consider moving up to 32GB. Taking it a step further, if you're using professional apps or running virtual machines, then 16GB is probably going to be a genuine limitation.

Note that the 32GB kits we tested

here have twice the number of memory chips as the 16GB kits (dual sided vs single sided) and this can lead to some performance gains as you can see on the benchmarks page.

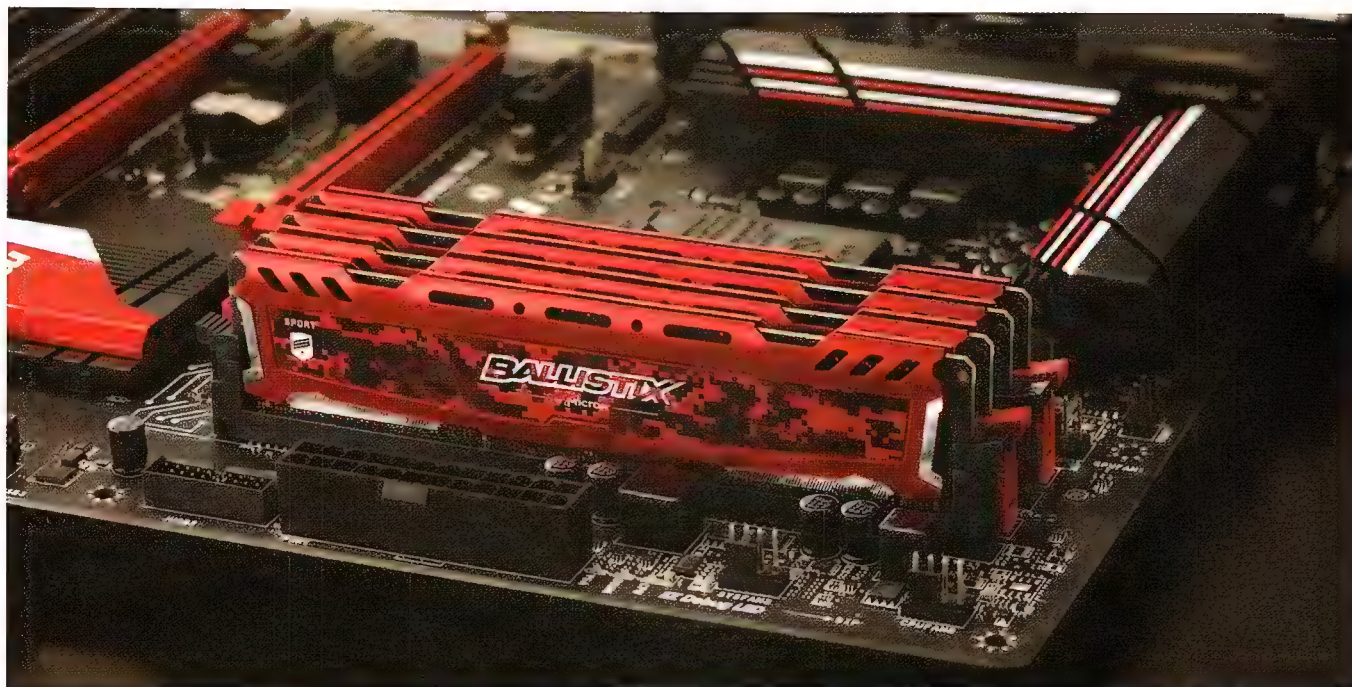
Whether you go for 32GB depends on your usage habits. 32GB is cheaper than ever and we aren't far away from 32GB offering a better dollar per GB ratio. Some applications will love it, but for the regular desktop user, it remains overkill.

SPEED AND TIMINGS: WHAT EFFECT ON PERFORMANCE?

The primary performance metric after a memory kit's speed is its CAS latency or CL. CL ratings are something of a misnomer as many consumers assume that a kit with a speed and CL of DDR4-3200 C16 is the same speed as a kit that's DDR3-1600 C8. While it's true that effective CAS latency remains the same between the two kits, it's just one timing and any latency losses that occur are offset by the overall increase in speed.

As you can see on the benchmarks

"Whether you go for 32GB depends on your usage habits. 32GB is cheaper than ever and we aren't far away from 32GB offering a better dollar per GB ratio."



page, we ran a series of tests at different speeds to represent what is considered generic (DDR4-2400 C15), to high performance (DDR4-3200 C14) and overclocked (DDR4-4000 C16) memory. When compared to our reviewed kits, some interesting results become apparent. Synthetic results including latency and raw bandwidth steadily improve, but the improvements in the benchmarks that show gains with memory bandwidth start to show diminished returns at higher speeds. The X.264 and gaming results in particular show decent gains when moving from DDR4-2400 to 3200, but significantly smaller gains when moving from 3200MHz to 4000MHz.

The results show that an affordable DDR4-3200 kit is currently the sweet spot for value and performance. You'll gain a decent chunk of performance over a generic DDR4 kit without spending a whole lot more. The high performance and overclocking kits at DDR4-4000+ are usually a lot more expensive, while not providing a lot in the way of performance gain. They're useful only for point chasing competitive overclockers or those who really want the best without compromise.

XMP

XMP stands for Extreme Memory Profile. It was developed by Intel to simplify the way to set the speeds and timings of a memory kit without having set everything manually. Most AMD motherboards also support XMP, but some also support AMD's AMP. It's essentially the same thing. XMP tends to work very well, but once you get into the higher speed tiers, it can be problematic. AMD's Ryzen 1st and 2nd

"RGB memory is a subjective topic. Do you want to show off your high performance PC or put it under the desk out of sight and out of mind?"

gen struggled with high RAM speeds, and Intel CPUs can also get finicky at high speeds. If you're looking to buy a very high speed kit, be prepared to do some manual tweaking in order to have it run properly. Some high speed XMP kits may simply be beyond the capabilities of your CPU's memory controller.

RGB IS EVERYWHERE

RAM manufacturers have extensive ranges of RGB equipped kits. A couple of years ago we'd have said that users seeking value or performance should stay away from RGB RAM. This is because RGB kits tended to be significantly more expensive. The gap is closing though.

The second reason is that RGB lighting tends to add electrical interference to sensitive RAM modules. You almost never saw high speed kits equipped with RGB for this reason. That's all changing now with most manufacturers comfortable with offering high end RGB RAM.

So if you want to bling up your system, you can combine looks and performance for not much more than the cost of the equivalent non-RGB kit.

PUTTING IT ALL TOGETHER

As you can see from looking at our benchmark results, DDR4-3200 is the

best choice right now. It offers the best combination of performance and value. The cost of RAM is continuing to fall and compared to where we were a year ago, 2x8GB of good quality DDR4-3200 is an absolute bargain. At 3200 MHz, performance is well ahead of generic RAM, but doesn't lose out much to high speed enthusiast and overclocking kits.

RGB memory is a subjective topic. Do you want to show off your high performance PC or put it under the desk out of sight and out of mind? The choice is yours. Will we look back in 20 years with nostalgia? Or will we be cringing?

Whether you want to look at your RAM or not, prices are continuing to fall. It's as good a time as any to upgrade your PC with 16GB or more of memory. If you're coming from 8GB, you can look forward to more responsiveness, fewer page file accesses and the ability to multi task much more. If you're building a new PC, then 16GB at DDR4-3200 is where you'll want to be. Paying more for faster RAM means diminishing performance returns, while going for cheaper RAM will bottleneck your system. Just a few extra dollars over something like 2666MHz RAM will be well worth it.



Adata XPG Spectrix D60G; 16GB (2x8GB) DDR4-3200 CL 16-18-18-36 at 1.35 V; XMP 2.0 support; Lifetime warranty.

\$159 | WWW.XPG.COM

Adata XPG Spectrix D60G

A unique memory kit from a company on the rise.

In such a crowded and competitive market, sometimes memory products have little to differentiate them. When a product like the Adata Spectrix D60G manages to undercut the competition on price, you simply have to sit up and take notice. At \$159 the Spectrix D60G offers the best value of the all the RGB kits in the roundup. Normally that alone would be enough to take out a winners gong, but this Adata kit is not some bargain basement kit.

The Adata Spectrix kit comes with primary timings similar to the other kits in this test at 16-18-18-36-2T. It's good to see Adata hasn't taken the easy option by equipping poor memory ICs. Its performance was consistently at or near the top of the 2x8GB kits thanks to some aggressive sub timings.

What really sets this kit apart is its RGB implementation. Many kits content themselves with lighting at the top of the

modules, whereas the Spectrix lighting effect covers a large proportion of the sides too. Adata claims 60% of the entire module is lit up. The plastic covering is highly opaque, though perhaps that last bit of vibrancy and definition is lost as a result.

Adata may not be the first name that comes to mind when it comes to performance DRAM, but the company sure is doing its best to make sure that it takes its place amongst the big players in the field. It's got a unique look, performs and overlocks well and is by far the cheapest kit in the roundup. What's not to like?

Verdict

This Adata XPG kit offers supreme value to go along with performance and a unique RGB design.



Aorus RGB Memory (with Demo Kit); 16GB (2x8GB) DDR4-3200 CL 16-18-18-38 at 1.35 V; XMP 2.0 support; Lifetime warranty.

\$205 (\$175 WITHOUT DEMO MODULES) | WWW.AORUS.COM

Aorus RGB Memory

Why settle for two modules when you can have four?

Gigabyte made a surprising push into the DRAM market in mid-2018 with its Aorus branded modules. What sets these apart is that a standard dual channel kit comes with optional dummy modules, which are perfect for making it look like your system is fully decked out with four.

The simply named Aorus RGB memory comes with 16-16-16-38 2T timings, where the TRAS of 38 is a little higher than some of the other competing kits.

We found that the Aorus memory was the weakest performing kit in the test and sometimes by some margin. The reason for this is several notably slower XMP sub timings. While this makes the kit widely compatible, it does have some performance impact, which is revealed in several of the benchmark tests. The difference isn't a lot compared to say, having a faster (or slower) CPU or GPU, but it's better to be

leading the pack rather than trailing.

The Aorus RAM definitely has great looks. Its colors are sharp and vibrant. It's always nice to see orange done well! Being a Gigabyte product, it has seamless integration with the Gigabyte RGB Fusion ecosystem.

While the Aorus kit is a great way to bling up your system with four modules (for just a bit more than the cost of two) the weak XMP performance of the Aorus kit counts against it compared to the faster and cheaper Adata kit. But if you're prepared to tweak it, then the Aorus kit comes right back into contention.

Verdict

Unique with its four modules, but its weak performance counts against it in a very tough field.





Corsair Vengeance RGB Pro; 16GB (2x8GB) DDR4-3200 CL 16-18-18-36 at 1.35 V; XMP 2.0 support; Lifetime warranty.

\$179 | WWW.CORSAIR.COM

Corsair Vengeance RGB Pro

Performance and good looks.

The Corsair Vengeance Pro is of course a DDR4-3200 kit with 16-18-18-36 timings. Though a look at the many tight XMP sub-timings reveals why the Corsair kit is often in near the top of the benchmarks leaderboard.

While looks are always objective, the Vengeance RGB Pro has a lovely design with its nice and dare we say simplistic metal heat sink. Our kit came with a black finish, though Corsair also offers it in white. The top section of the module is lit with RGB LEDs and the colors are notably distinct and rich.

Corsair's iCUE software deserves a mention. Of course it controls the RGB effects of the Vengeance Pro kit and it can control other Corsair products too. It also offers additional functionality such as monitoring and timing information, useful if you're overclocking.

Speaking of overclocking, the Corsair kit was the

equal best of the bunch, able to hit DDR4-3866 with 1.4V at its XMP timings. This would point to Corsair using a premium or binned IC in this kit and would go a long way to explaining its relative price premium. Since vendors are known to change IC, we'd be wary of saying that all kits will perform like this.

The Corsair Vengeance RGB Pro is a great blend of stock performance, RGB good looks and overclocking ability. Throw in the excellent functionality of the Corsair's iCUE software too. While it costs a bit more than some of the other kits in the roundup, the whole package makes this a top quality kit.

Verdict

Blends strong performance with fantastic looks and iCue ecosystem compatibility.



Crucial Ballistix Sport LT; 32GB (2x16GB) DDR4-3200 CL 16-18-18-36 at 1.35 V; XMP 2.0 support; Lifetime warranty.

\$268 | WWW.CRUCIAL.COM

Crucial Ballistix Sport LT

A no fuss 32GB kit that's all about value.

Here we have the first of two 2x16GB kits in our roundup. Crucial's Ballistix Sport LT doesn't have any RGB lighting and is in fact quite subtle with its simplistic design, but that's something that won't bother a user who doesn't care about looks.

The Ballistix Sport LT kit is the only standard profile kit in our test. This makes it well suited to users who use very large air heat sinks. While it's not as big a problem as it used to be, tall RAM can still interfere with air coolers that don't take RAM height into consideration.

As a 2x16GB kit with a dual rank design, the Crucial was actually the best performing kit in the entire roundup. The margins as always are small but a look at the benchmarks shows how dual rank memory helps performance, though it does mean there's a tiny latency hit. Where the Crucial Ballistix LT kit excels is its

value. At \$268 it's proof of just how much DRAM prices have fallen in recent times. It's not all that much higher than some of the 2x8GB kits and it adds that extra degree of future proofing. Of course if you're dealing with large data sets, several memory hogging applications or even alt-tab out of games and want to minimise page file access, then 32GB can come in handy.

The Crucial Ballistix Sport LT offers terrific value, which along with great performance and a highly compatible low profile design makes it a solid choice for those looking to make the jump up to 32GB.

Verdict

Crucial's Ballistix sport is priced at a level that makes upgrading to 32GB more compelling than ever.





Kingston HyperX Predator; 32GB (2x16GB) DDR4-3200 CL 16-18-18-36 at 1.35V; XMP 2.0 support; Lifetime warranty.

\$329 | WWW.HYPERXGAMING.COM

Kingston HyperX Predator

A quality kit that needs a price adjustment.

Kingston's HyperX Predator is the second of two 3200MHz 32GB kits in our roundup. A 2x16GB kit is perfect for demanding users or those limited to two memory slots such as you'd find on an ITX motherboard. Its primary timings are 16-18-18-36 at 1.35v. The Kingston HyperX Predator is a non RGB kit. While it's perfectly suitable for a gamer thanks to its inherent double rank performance advantage (albeit a small one) its lack of RGB means it probably won't find its way into a blinged up system. That will suit many people just fine.

The Hyper X kit shares quite a lot in common with the Crucial kit. In fact other than a few secondary sub-timings, the entire list of timings we could read were identical. Although time constraints with so many different kits prevents us from really dialing in the best overclock

for each kit, the Crucial and Kingston kits had about the same overclocking headroom too. It topped out at 3733MHz at XMP timings and 1.4V.

The problem Kingston has with this kit is its value, or lack thereof at the time of writing. With so little to differentiate a lot of kits, if one falls behind on price alone then it takes a big hit. While it's a highly capable kit, it needs a price drop to return it to competitiveness. Do check the pricing engines for the latest pricing as with almost daily market volatility, our quoted price may well have been adjusted downwards from the time of writing.

Verdict

Kingston's HyperX Predator is an excellent 32GB memory kit that we're hoping gets a more



competitive price.



G.Skill Trident-Z Royal; 16GB (2x8GB) DDR4-3200 CL 16-18-18-38 at 1.35 V; XMP 2.0 support; Lifetime warranty.

\$219 | WWW.GSKILL.COM

G.Skill Trident-Z Royal

Memory with looks suitable for royalty.

G.Skill is well known in overclocking circles for its willingness to push the envelope with ever faster memory kits. If you're after maximum performance, G.Skill is usually in the shortlist.

The Trident-Z range has been available in one form or another for many years, but never has it looked like this. It comes sheathed in a magnificent mirror like silver or gold finish. It really does give that wow factor when you open the box for the first time. Even the packaging is a premium match for the kit. The gorgeous finish is complemented by a sparkling crystalline light bar. As it's a clear plastic material, the colors are especially vibrant and accurate. Colors bounce around everywhere. Look are always subjective, but this is the best looking memory kit I've personally ever seen.

The G.Skill kit's performance was about in

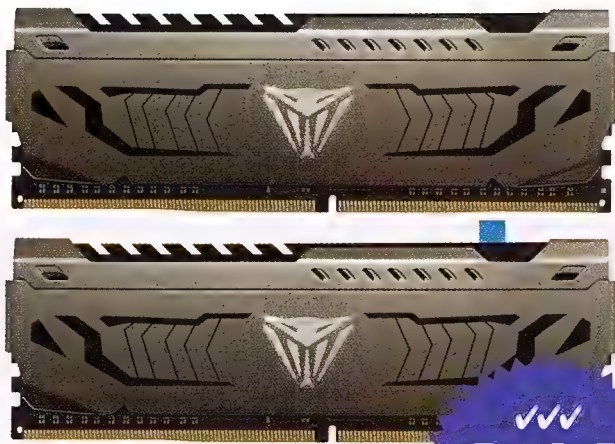
the middle of the pack. Where it excelled was its overclocking performance. While it doesn't come with Samsung B-Die like you'd likely find in a 3200 C14 kit, for the lesser spec kit, its OC was still noteworthy compared to the other kits in the test.

The Trident-Z Royal carries quite a bit higher price compared to some of the other kits, which hurts it in an especially competitive market. But its supreme good looks and roundup leading overclocking ability elevates it. As with the other kits in the test, pricing is volatile right now, but as a premium product, it's always going to carry a bit of a premium price.

Verdict

A gorgeous memory kit with plenty of OC headroom, though it carries a bit too much of a price premium.





Patriot Viper Steel Series; 16GB (2x8GB)
DDR4-3200 CL 16-18-18-36 at 1.35 V; XMP 2.0
support; Lifetime warranty.



\$149 | WWW.PATRIOTMEMORY.COM

Patriot Viper Steel

One to look out for
if you're looking for value.

Patriot is a brand that doesn't have the Australian market presence of the likes of Corsair or G.Skill, but that doesn't mean that it's not well regarded in the global PC market. The company is also popular amongst gamers with its Viper Gaming brand.

The Patriot Viper Steel we have on hand to test is the cheapest kit in the roundup. It matches all of the other kits with its CL 16-18-18-36 primary timings so stock performance doesn't suffer in any way. Of course as a value oriented kit it doesn't come with RGB or an extravagant heat sink. Its grey metal covering is well suited to a neutral color build.

As a budget kit, these modules are likely using more affordable Hynix ICs which aren't known for their overclocking prowess. At \$149 this is more of a set XMP and forget type of kit. If you

want to OC, you'll have to jump up in price to a 3200 MHz 14-14-14 kit which should have the more OC friendly Samsung B-Die IC's installed.

The Patriot Viper Steel Series kit is a good strong value offering. Forget about bells and whistles. This is a kit you should be looking at as a step above the 2400 or 2666MHz kits. You'll get a boost in performance without having to spend a lot more. It's a good kit, even if it's rather unremarkable. Not everyone cares about RGB bling though, so that suits a lot of folks just fine.

Verdict

The Patriot Viper Steel kit is a good, solid competitor and offers good value.



Team T-Force Night Hawk RGB; 16GB (2x8GB)
DDR4-3200 CL 16-18-18-38 at 1.35 V; XMP 2.0
support; Lifetime warranty.

\$169 | WWW.TEAMGROUPINC.COM

Team T-Force Nighthawk RGB

Attention grabbing memory.

Take one look at Team's Night Hawk memory. It's definitely got the most extravagant design of all the kits in the roundup. If you're after something eye catching, it's one that you'll want to strongly consider.

The Team Night Hawk RGB memory has impeccable build quality. It just feels solid, weighty and well made. The white heat sink of our test kit extends well beyond the top of the modules so this will be something to keep in mind of you're planning to use a large air cooler. We can't imagine you'd be doing that though. This is a show off kit for a water-cooled build! It's also got an interesting default RGB effect with a fast pulse to go along with rotating colors.

The Night Hawk comes in at \$169 which isn't a bad price at all for an RGB kit. Just a few months ago this kit would have been worth a lot more.

Performance wise, the kit was in the middle of the pack, as we'd expect with Hynix equipped kits with similar timings. We should note that the kit's overclocking wasn't that great. With DDR4-3600 at 1.4V with the default XMP timings being unstable. But again, this isn't the kind of spec kit you'd buy for a maximum OC. This is one that sits in the performance sweet spot whilst looking great.

You'll know if this kit appeals to you after just one look. If its aggressive design appeals to you, then combined with its great value, it comes highly recommended.

Verdict

Team's Night Hawk RGB memory will command attention in a white themed show build.



PERFORMANCE TESTING

	AIDA64 MEMORY READ (MB/S)	AIDA64 MEMORY WRITE (MB/S)	AIDA64 MEMORY COPY (MB/S)
ADATA SPECTRIX D60G 2X8GB	46,668	46,244	41,608
AORUS RGB MEMORY 2X8GB	46,327	46,071	41,151
CORSAIR VENGEANCE PRO 2X8GB	46,588	46,215	41,495
CRUCIAL BALLISTIX SPORT LT 2X16GB	47,754	48,317	45,261
KINGSTON HYPER X PREDATOR 2X16GB	47,401	48,123	45,651
G.SKILL TRIDENT-Z ROYAL 2X8GB	46,888	46,063	41,904
PATRIOT VIPER STEEL 2X8GB	46,943	45,908	41,366
TEAM T-FORCE NIGHTHAWK 2X8GB	46,437	45,992	41,267
REFERENCE DDR4-2400 15-15-15 2X8GB	35,487	34,849	32,792
REFERENCE DDR4-4000 16-16-16 2X8GB	58,148	48,182	43,871
REFERENCE DDR4-3200 14-14-14 2X8GB	47,711	46,512	43,438

	AIDA64 MEMORY LATENCY (NANOSECONDS)	7ZIP (MILLION INSTRUCTION PER SECOND)	X264 FHD VIDEO ENCODING (FPS)
ADATA SPECTRIX D60G 2X8GB	44.9	57,066	65.76
AORUS RGB MEMORY 2X8GB	44.9	53,627	65.63
CORSAIR VENGEANCE PRO 2X8GB	45.0	56,956	65.92
CRUCIAL BALLISTIX SPORT LT 2X16GB	46.8	59,610	66.19
KINGSTON HYPER X PREDATOR 2X16GB	46.9	59,567	65.95
G.SKILL TRIDENT-Z ROYAL 2X8GB	45.0	55,575	65.85
PATRIOT VIPER STEEL 2X8GB	45.0	56,411	66.01
TEAM T-FORCE NIGHTHAWK 2X8GB	44.9	55,428	65.76
REFERENCE DDR4-2400 15-15-15 2X8GB	53.7	50,848	64.05
REFERENCE DDR4-4000 16-16-16 2X8GB	37.8	59,205	66.81
REFERENCE DDR4-3200 14-14-14 2X8GB	41.3	55,958	66.08

"If you're building a new PC, then 16GB at DDR4-3200 is where you'll want to be."

	3DMARK TIME SPY (PHYSICS SCORE)	CINEBENCH R20 (SCORE)	GHOST RECON: WILDLANDS (1080P, LOW, AVG FPS)
ADATA SPECTRIX D60G 2X8GB	11,527	5281	185.0
AORUS RGB MEMORY 2X8GB	10,714	5286	181.5
CORSAIR VENGEANCE PRO 2X8GB	11,428	5294	185.2
CRUCIAL BALLISTIX SPORT LT 2X16GB	11,907	5296	186.3
KINGSTON HYPER X PREDATOR 2X16GB	11,898	5291	186.5
G.SKILL TRIDENT-Z ROYAL 2X8GB	11,220	5289	184.4
PATRIOT VIPER STEEL 2X8GB	11,380	5287	185.0
TEAM T-FORCE NIGHTHAWK 2X8GB	11,431	5300	184.9
REFERENCE DDR4-2400 15-15-15 2X8GB	10,212	5279	176.1
REFERENCE DDR4-4000 16-16-16 2X8GB	12,111	5304	188.1
REFERENCE DDR4-3200 14-14-14 2X8GB	11,466	5304	185.0

	MIDDLE EARTH: SHADOW OF WAR (1080P, LOW, AVG FPS)	COUNTER STRIKE: GLOBAL OFFENSIVE (1440P, MAX, AVG FPS)
ADATA SPECTRIX D60G 2X8GB	228	337.42
AORUS RGB MEMORY 2X8GB	227	334.59
CORSAIR VENGEANCE PRO 2X8GB	229	336.51
CRUCIAL BALLISTIX SPORT LT 2X16GB	228	335.66
KINGSTON HYPER X PREDATOR 2X16GB	229	335.94
G.SKILL TRIDENT-Z ROYAL 2X8GB	228	335.70
PATRIOT VIPER STEEL 2X8GB	228	335.98
TEAM T-FORCE NIGHTHAWK 2X8GB	228	336.67
REFERENCE DDR4-2400 15-15-15 2X8GB	215	323.73
REFERENCE DDR4-4000 16-16-16 2X8GB	235	339.60
REFERENCE DDR4-3200 14-14-14 2X8GB	232	336.56

60

OFFICE TIPS

Get more out of Microsoft Office and LibreOffice with help from Nick Peers.

After Windows, your office application is likely to be the most-used app on your PC. Whether it's creating written documents, crunching numbers or building slideshows, virtually everyone needs – and uses – an office suite. In the past, that almost invariably meant some flavour of Microsoft Office, and it remains by far the most popular paid-for office app, whether you own a full copy or have an Office 365 subscription.

Today, though, Office has been eclipsed by free alternatives, and its biggest rival is now LibreOffice, capable of offering most Microsoft Office features, boasting excellent compatibility with Office file formats

and throwing in some clever features of its own. But it doesn't matter whether you're an Office or LibreOffice user, we have just the collection of tips *for you*.

We'll cover the most popular parts of both suites – Word/Writer, Excel/Calc and PowerPoint/Impress as well as tips that apply across all apps – and we've dug out no fewer than 60 secrets, timesavers and cool features you may not be aware of – we've covered the latest version of both suites (Office 365 and LibreOffice 6.2), but many tips can be adapted for older versions, too. Throw in another 40 keyboard shortcuts and you'll come away from this feature with even more Office knowhow.

General Office tips

SAVE TO COMPUTER BY DEFAULT

Microsoft is incredibly keen for you to save directly to OneDrive in later versions of Office, but it's sluggish and slow. Open File > Options > Save and ensure 'Save to Computer by default' is ticked, then pick a default folder. From the February 2019 update you can do this via the new Save This File dialog that pops up when saving a new document: click the Location drop-down menu for a list of recent folders, right-click one and choose 'Set as Default Location'.

MORE DEFAULT SAVE OPTIONS

File > Options > Save is where you go to also change the default location for any personal templates you create in each separate Office application – here, however, you need to manually type (or copy and paste from File Explorer) your chosen location into the 'Default personal templates location' box.

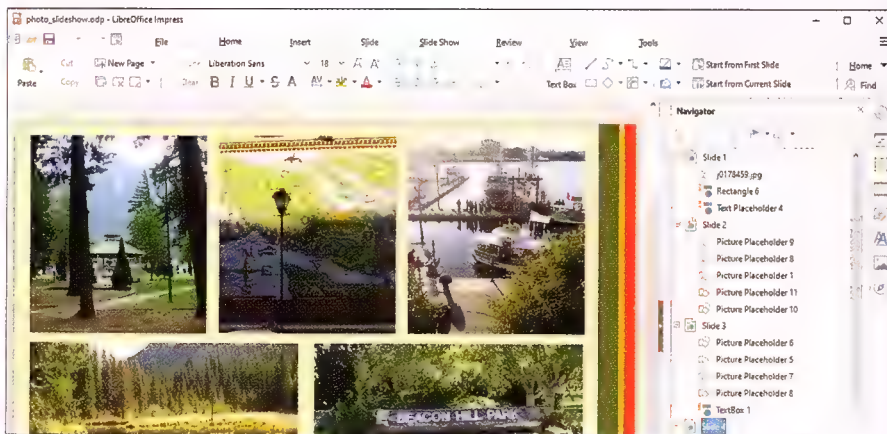
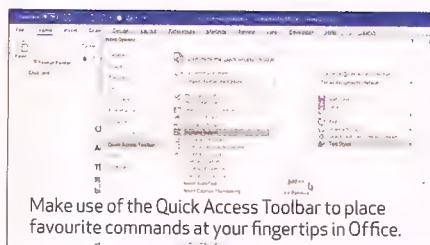
Things are easier in LibreOffice: select Tools > Options > Paths where you'll find a host of folders covering My Documents, templates, dictionaries, autocorrect files and more can be moved – select your chosen setting and click 'Edit...' to change it, then Apply.

MAKE USE OF STYLES

Most office applications provide some form of Styles or formatting tool to help you make your documents look consistent. Get in the habit of using these – favouring Body Text over Normal if you make use of the various Headings – as opposed to manually styling up each element. In Office, press Ctrl-Alt-Shift-S to bring up the Styles pane (press F11 in LibreOffice) – drag it to the right-hand side of the window to anchor it if needed. Right-click an existing style to modify it – In Office, you can also style up some text in your document, then select it, right-click the target style in the Styles pane (or on the Ribbon) and choose 'Update... to Match Selection'.

ENABLE THE RIBBON

LibreOffice now has a similar tabbed Ribbon-like interface to Microsoft Office – switch to it by selecting View > User



Interface > Tabbed (a Tabbed Compact option is also available). Once enabled, click the Settings button in the top-right corner to access key functions including the User Interface option to switch back. Sadly, it's not (yet) customisable.

CUSTOMISE THE RIBBON

You can easily customise all aspects of the Ribbon in Microsoft Office – including removing and adding elements to each tab: right-click on some empty space on the Ribbon and choose 'Customise the Ribbon' to tweak existing Ribbon elements by adding and removing as required.

If you frequently switch between tabs to access favourite commands, why not go one step further and copy them all to a single tab? Click 'New Tab' followed by Rename and enter a name for your tab. You can also create groups within this tab in a similar way to help organise your commands logically. Select the tab and group that you want to customise and pick a tool from the list on the left. Click 'Add' to add this to the group. Next, click 'OK' to review your changes and perform more tweaks (like rearranging the tab's position on the Ribbon) as necessary.

MAKE USE OF THE QUICK ACCESS TOOLBAR

Office's Quick Access Toolbar sits above the Ribbon as a handy alternative to a new Ribbon tab, and by selecting More Commands from its drop-down menu you can place more commands within a single click's reach. Click the 'Choose commands from' drop-down menu to target those not in the Ribbon or hidden away behind multiple clicks like the Keep Text Only option under Paste (particularly useful in PowerPoint).

You'll notice some items come with a generic circle icon, which makes them hard to distinguish. It's possible to customise these icons, although this

involves some editing of hidden files in a text editor. If that doesn't put you off, visit tinyurl.com/APC47ITWEAK for a full step-by-step guide.

CUSTOMISE THE LIBREOFFICE TOOLBAR

If you don't switch on the Ribbon in LibreOffice, you will find the controls for customising its toolbar work in a similar way to Office's tools: choose Tools > 'Customise...' > Toolbars to do so.

VIEW DOCUMENTS SIDE-BY-SIDE

Want to view different parts of the same document in the same window? The solution lies in splitting the screen: in Word and Excel, switch to the View tab on the Ribbon. Scroll to the point in the document where you'd like the split to appear and click Split under Window. Each one now works independently of the other and you can click and drag the split to make one side larger than the other. When you're finished, double-click the split line to remove it and return to a single-paned view. The feature is also available in LibreOffice Calc: choose View > Split Window.

COMPARE DOCUMENTS

If you have two different versions of the same document, you can compare the differences between them even if you forgot to switch Track Changes on. The feature is available in both Word and PowerPoint as well as LibreOffice Writer: look under the Review tab on the Ribbon of all three apps for the Compare button. You can then either step through the changes between the two versions of your document, or view them with additions, deletions and other edits clearly marked.

LINK PICTURES

When you traditionally insert an image into a document, a physical copy of that image is created and embedded in your

document. However, it's also possible to link rather than embed a picture – the advantages being that your document size is kept down and any changes to the original image are also updated in the document. On key disadvantage, though, is that if you lose the picture file you originally linked to, it will also disappear from the document image.

To link rather than embed a picture in Office, insert a picture from a file in the usual way, but click the down arrow next to the Insert button where you'll see options to create a direct link as well as link and embed the file. In LibreOffice, you should tick the Link box to link rather than embed a file.

MULTIPLE CLIPBOARD ITEMS

By default, Office stores everything you copy or cut to the clipboard during the current session – across all open Office apps. To view and access these, make the Clipboard Pane visible by clicking the Clipboard's More button on the Ribbon's Home tab.

PASTE SMARTLY

By default, Office pastes items in a specific way – either retaining the source formatting or attempting to match it to the document styles it's been pasted into. You can override this behaviour via the Paste drop-down button on the Home tab – you'll see options for plain text as well as a special option that enables you to paste it in a specific format, such as HTML code. Some Office applications, such as Word, enable you to choose a different default paste behaviour – look under File > Options > Advanced – and tailor it to specific paste events, such as pasting text from other documents or apps.

There's no default setting in

LibreOffice, but you can bypass the frustrating Paste Special menu by mastering keyboard shortcuts. Don't like the current combination for unformatted text (Ctrl-Alt-Shift-V)? Select 'Tools > Customise... > Keyboard' and select 'All commands > Paste Unformatted Text' to change it.

PASTE FORMATTING

Need to restyle a block of text or object to match another? Simple: first, select the object containing your desired style. Next, click the Format Painter (Office) or Clone Formatting (LibreOffice) button. Finally, click the paragraph or object you wish to restyle.

Note: in LibreOffice, only the character formatting is cloned by default – to apply paragraph formatting as well, hold Ctrl-Shift as you click.

SHRINK TO FIT

Frustrated because the document you want to print runs on to a new page by just a couple of lines or so? If you're using Microsoft Excel, click the More

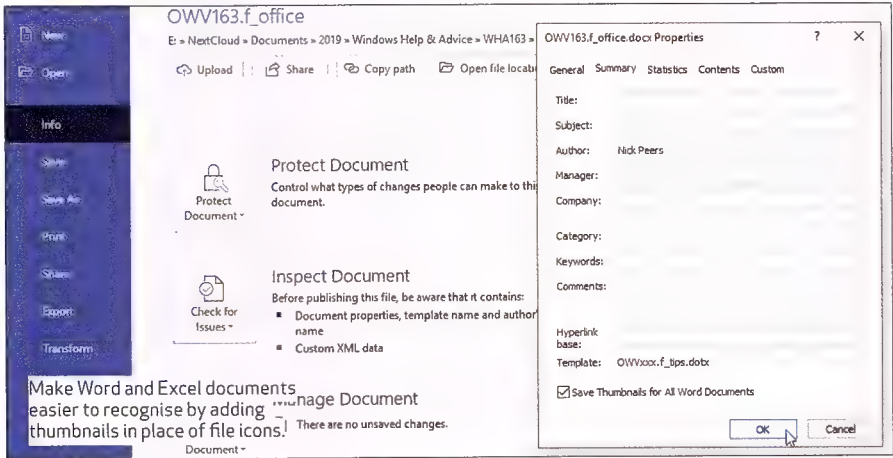
button under Page Layout > Page Setup and use the 'Fit to' options to scale accordingly; in LibreOffice's spreadsheet app, Calc, select Format > Page > Sheet and look under Scale.

In Word, to add the Shrink One Page command to a suitable Ribbon tab or the Quick Access Toolbar. When clicked, Word will attempt to resize document fonts to reduce the page count by one.

ADD THUMBNAIL ICONS TO OFFICE DOCUMENTS

It's possible to replace the default Office icons with thumbnail previews of your documents. To apply a preview to a single document only, look for the Save Thumbnail option in the Save As dialog.

You can make this the default behaviour in Word and Excel – each application needs to be tackled separately. Navigate to File > Info, click Properties and choose Advanced Properties. You'll see a 'Save Thumbnails for all Excel Documents' command or similar. Tick this and click OK to apply across all your documents.



10 general Office shortcuts

The following shortcuts work across most Office and LibreOffice apps.

Shortcut	Points to
Ctrl-X/Ctrl-C/Ctrl-V	Cut, copy or paste selected item
Ctrl-N/Ctrl-O	Create new document/open existing document
Ctrl-P	Print current document
Ctrl-W	Close open document
Ctrl-F/Ctrl-H	Launch the Find dialog/launch the Find/Replace dialog
Ctrl-Z	Undo the last action
Ctrl-Y	Repeat the last action or redo an undone action
Ctrl-Ctrl-Home/Ctrl-Ctrl-End	Select everything before/after the cursor
Ctrl-mouse wheel	Quickly zoom into or out of any open document
Ctrl-[/ Ctrl-]	Decrease/increase font size by a single point

Word and Writer

SELECT TEXT QUICKLY

Double-click a word once to select it, or triple-click to select an entire paragraph. In Word, hold Ctrl as you click to select the sentence. Hold down Alt and click and drag to select a block of text.

SUPER-SMART SELECTIONS

There's a handy option under Editing on Word's Home tab called Select – click this and you'll see an option to 'Select Text with Similar Formatting', which enables you to quickly select all text with the same style as the current selection. The feature isn't available in LibreOffice Writer, but it is available when editing documents online in Google Docs – position your cursor, right-click and choose 'Select all matching text', which produces matches based on font, style and colour as well as styles.

INCLUDE MISPELLED WORDS IN SEARCHES

When searching for a specific word using the 'Find and Replace' dialog box, you can allow for misspellings – for example, 'there' instead of 'their'. In Word, click 'More>>' and tick the 'Sounds Like (English)' box to do so. It's also possible to search for variations like 'went' and 'gone' when searching for 'go' by ticking the 'Find all word forms (English)' box, too.

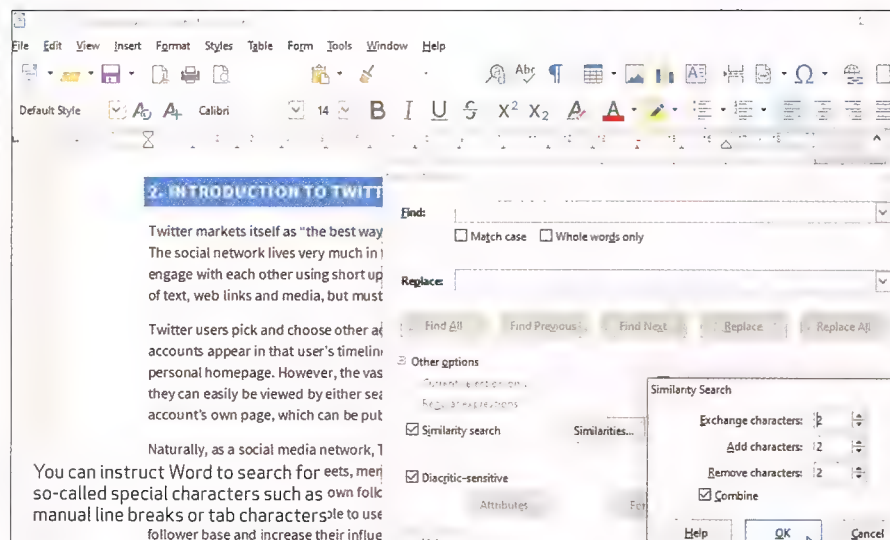
In LibreOffice, tick 'Similarity search' and then click the Similarities box to define the levels of difference if too few or too many variations are found.

REMOVE UNWANTED CHARACTERS

You can also instruct Word to search for so-called special characters such as manual line breaks or tab characters – place your cursor in the 'Find what' box before clicking the Special drop-down menu to select one. Similar options can be found in LibreOffice by clicking the 'Attributes...' button.

USE AN EXCLUSION DICTIONARY

When your word processor is set to highlight so-called misspellings (basically any word not in your dictionary), there may be certain words you want to flag up even if they exist in the default dictionary. To do this in Word, press Win-R, type %AppData%\Microsoft\UPProof and click OK. Right-click the English exclusion dictionary file – ExcludeDictionaryEN0809.lex – and choose 'Open with' > 'More apps', select your text editor (untick 'Always use this app to open LEX files') and click



OK. Now simply add each word you want to exclude on separate lines, save the file and they should be flagged in Word going forward.

Things are even easier in LibreOffice Writer: go to Tools > Options > Language Settings > Writing Aids. Click New to create a user-defined dictionary and be sure to tick 'Exception (-)' to create an exclusion dictionary, which you can then add words to by selecting it and clicking Edit.

SAVE MULTIPLE FILE VERSIONS

One way to save different revisions of the same file is to store them in a cloud folder, but you have no control over which versions actually get saved. In Writer, you can choose File > Versions to save multiple versions of the same file within one document – each version is accompanied by a date and time, and you can add comments, then compare changes, move between them and so on. The feature is also present in earlier versions of Word but was dropped from Word 2013 on.

MAKE USE OF AUTOTEXT

Save set blocks of text including tables and formatting to use later with AutoText in Word and Writer. Enter and format the text as you'd like it to appear in future documents. With the text selected, choose Tools > AutoText (Writer), pick a category for your text, give it a suitable shortcut name longer than four characters and click AutoText > New > Close.

In Word, you need to click the QuickParts button on the Ribbon's Insert tab in Word and choose AutoText followed by 'Save Selection to AutoText Gallery'. Complete the information in the Create New Building Block dialog, ensuring that the Normal template is

selected if you want to use this block of text in future documents. Click 'OK'.

To add the block of text to any future document, type the phrase or shortcut you assigned to it and press F3.

AUTOTEXT AND PHOTOS

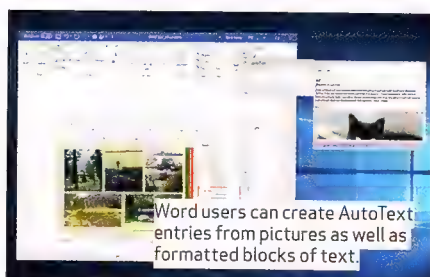
In Word, you can also store images as AutoText entries for quick insertion into documents. Insert the picture into a blank document, select it and click the QuickParts button as before and repeat the same steps. Again, assign it a suitable name that can be used as a shortcut to quickly insert into the document by typing the name and pressing F3.

GET ONLINE DEFINITIONS

Come across a word or phrase you need to learn more about? Right-click it in Word and choose Smart Lookup to open a pane where you can explore Wikipedia and other related web results, plus gain a definition by selecting Define.

FIND ALTERNATIVE WORDS

Sometimes you can find that words repeat themselves in a document. Luckily, you can find alternatives with your word processor's help: just right-click the word in question and select Synonyms for some alternative



suggestions (select one to replace the text with it) or choose Thesaurus to open the Thesaurus pane or dialog.

CHANGE TEXT CASE

Both Microsoft Word and LibreOffice Writer make it easy to change the case of a selected sentence – look for the ‘Aa’ button on Word’s Ribbon for options including sentence case, all caps and toggle case. LibreOffice buries its case-change features under the Format > Text menu. The same options are available in both suites, along with a Cycle Case option that cycles between uppercase, lowercase, capitalise each word and sentence case – press Shift-F3 to do so.

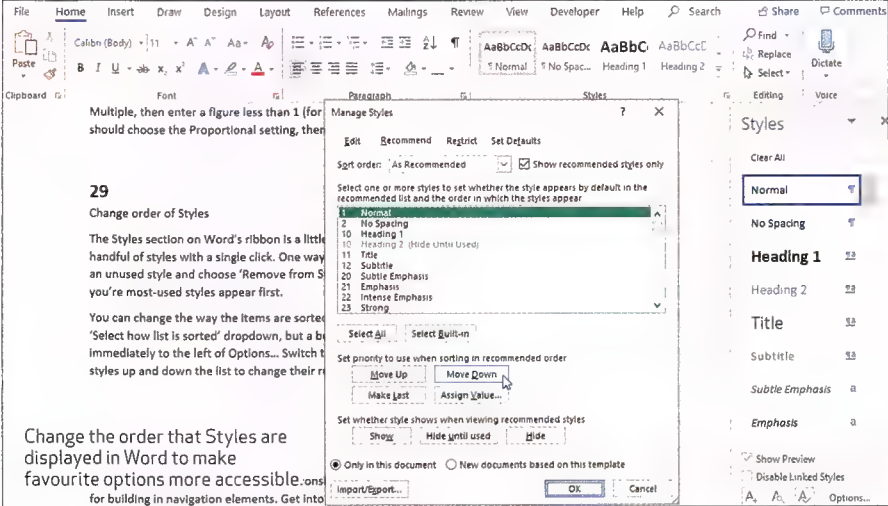
MORE CASE CHANGES

You can also change case through a Find and Replace action: make sure that Match Case isn’t ticked (under ‘More>>>’ in Word), then type the word or phrase in the Find dialog box before repeating it – with the case set correctly – in the Replace box. This ensures all instances of that word or phrase will be converted when you click ‘Replace All’.

If you’d like to change case using formatting – in other words, apply small caps or all caps – then click the Format button and choose Font to apply them in Word; In Writer, you will find the options hidden away under the Effects drop-down on the Font Effects tab.

REDUCE LINE SPACING

Click the Line Spacing button on the Ribbon (look under Home > Paragraph in Word; Format > Paragraph > Indents & Spacing in Writer) to access advanced line spacing options. Want to reduce the gap between lines, for example?



Check that both Above and Below spacing options are set to 0. What if you want to reduce the spacing to below 1? In Word, set the Line Spacing drop-down to Multiple, then enter a figure less than 1 (for example, 0.7). Click ‘OK’ to see the effect. Writer users should choose the Proportional setting, then enter a percentage figure less than 100.

CHANGE ORDER OF STYLES

The Styles section on Word’s Ribbon is a little cramped, meaning that often you can only access a handful of styles with a single click. One way to improve matters is to streamline the list: right-click an unused style and choose ‘Remove from Style Gallery’. Another option is to reorder the list, so you’re most-used styles appear first.

You can also change the way the items are sorted by clicking ‘Options...’ on the Styles pane using the ‘Select how list is sorted’ drop-down, but a

better way is to click the Manage Styles button immediately to the left of ‘Options...’. Switch to the Recommend tab and you’ll see controls for moving styles up and down the list, enabling you to change their running order.

BUILD IN NAVIGATION ELEMENTS

Styles aren’t just used to provide some consistent formatting to your document; they’re also useful for building in navigation elements. Get into the habit of organising your document using Heading and Body styles, and you’ll be able to quickly and easily build a table of contents using the heading styles to automatically mark chapter and section points.

Look for the table of contents controls on the References tab on the Word and Writer Ribbons; if you’re sticking with the classic (that is non-Ribbon) look in Writer, you’ll find all the navigation tools you need on the Insert menu.

10 word-processing shortcuts

All shortcuts work in both Word and LibreOffice Writer except where stated

Shortcut	Action
Ctrl-K	Create a hyperlink
Ctrl-arrow keys	Move to previous/next word
Home/End	Move to the beginning/end of the line
Ctrl-Home/Ctrl-End	Move to beginning/end of document
Ctrl-1, 2 or 5	Set single, double or 1.5 line spacing (Word only)
Alt-Ctrl-0, 1, 2, 3	Apply Normal, Heading 1, Heading 2, Heading 3 styles (Alt not required in Writer)
F7	Open spellchecker
Ctrl-L/Ctrl-R/Ctrl-E	Align text left, right or centre
F11 / Shift-F11 / Ctrl-Shift-F11	Manage Styles / New Style / Update Style (Writer only)
Ctrl-Enter / Ctrl-Shift-Enter	Insert a page/column break

Excel and Calc

DUPLICATE DATA ENTRY

Want to enter the same data into more than one cell at once? Enter your first cell's data, then click and drag the selection right (columns) or down (rows) to fill those cells with the same information. Once done, click and drag again if you want to duplicate the data across multiple cells or columns at once. To duplicate data across multiple sheets, select all the sheets (use Shift-Ctrl as you click each one), then type your data. It'll be replicated in the equivalent cell across your selection.

FREEZE ROWS AND COLUMNS

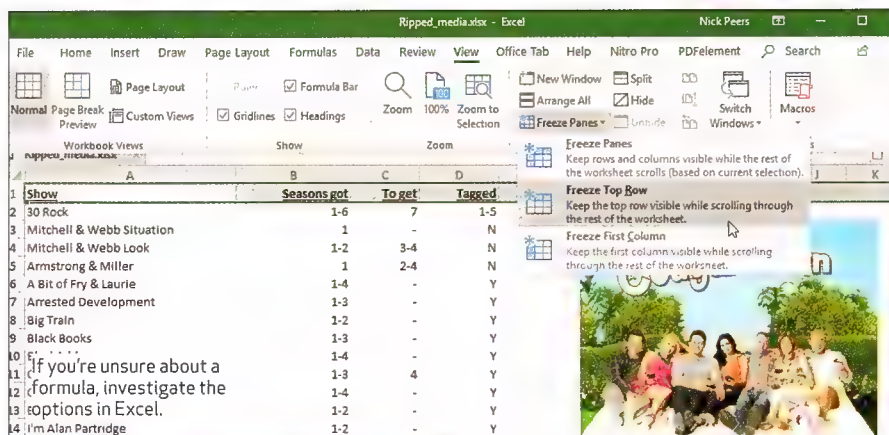
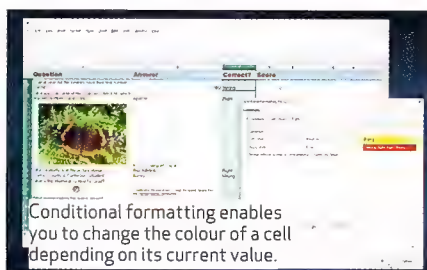
When you work in large spreadsheets, it's common to define the first row and/or column as headings or titles to help you navigate your data. Of course, as your spreadsheet grows, those header fields disappear. Prevent that happened by 'freezing' these key rows or columns so they always remain visible.

In Excel, click the Freeze Panes button on the Ribbon's View tab – you can opt to freeze just the first row or column, or freeze a larger selection if needed (choose Freeze Panes again). In LibreOffice Calc, you will find both options ('Freeze Rows and Columns' and Freeze Cells > 'First Column / First Row') under the View menu.

CLIPBOARD CONSIDERATIONS

Copying data into, between and out of spreadsheets is an artform in itself. Start by avoiding the clipboard for complex data sets in Excel – instead, use the options in the 'Get & Transform Data' section of the Ribbon's Data tab to choose the type of data you're bringing in to ensure it's formatted correctly. 'Link to External Data' works in a similar way in Calc.

When copying and pasting formulas and data between worksheets, first Ctrl-click on the worksheet tab where you plan to copy the data to. Now navigate to the cell containing the data you want to transfer – press F2 to activate the cell, then press Enter to copy the data into the corresponding cell in the other worksheet.



USE ABSOLUTE REFERENCES

All cell references in spreadsheets are relative by default – this means if you copy and paste a cell elsewhere it'll change to reflect its new location. For example, if you copied cell A3 containing the reference =SUM(A1:A2) to cell B3, it'll change the reference to represent =SUM(B1:B2).

If you want cell references to remain the same wherever they're posted, place a \$ before the row and column reference, so =SUM(\$A\$1:\$A\$4) would always provide the totals of cells A1, A2, A3 and A4 regardless of where you moved or copied the formula around your spreadsheet. It's possible to provide mixed references – \$A1, for example, would always refer to column A, but the row number would change depending on where the formula was pasted to; similarly, A\$5 would always refer to row 5, even though the column would change.

EASY REFERENCE CELLS

If you frequently refer to specific cells, assign a memorable name to a cell or cell range for easy referencing elsewhere in your document. Cells can be named with a mixture of letters and numbers, plus the backslash (\) and underscore (_) characters. You may not begin a name with a number.

There are two ways to define names: one is to simply select a cell or group of cells, then enter a suitable name into the Name box (to the left of the 'fx' box). The name will be assigned an absolute cell reference that includes the sheet name – Sheet1!\$A\$1, for example.

ASSIGN NAMES TO FORMULAS

Alternatively, click Define Name on the Ribbon's Formulas tab (Sheet > 'Named Ranges and Expressions' > Define in Calc) to define a name for a formula with relative or absolute references, or to generate new names from a combination of existing ones. Just type the formula into the 'Refers to:' or

'Range or formula expression' box, give it a suitable name and click OK. To use the formula, type =name into the cell in question, replacing name with your formula's name.

Use the Define Name box to update existing names, highlighting another advantage of using them: update the cell reference or formula here, and all of the references across your spreadsheet will update automatically too, saving you the hassle of locating and updating each one manually.

EXPAND YOUR SELECTION

To change the number of cells referred to in a formula, drag the blue range finder over the cells that you want to include in your new calculation.

VERIFY FORMULAS

If you're unsure about a formula, investigate the options in Excel's Formula Auditing section on the Ribbon's Formulas tab. You can see which cells are affected by the formula, troubleshoot errors and also click Evaluate Formula to work through complicated formulas to see how they arrive at their final figure.

Calc's error-checking tools can be found in the Function Wizard (Insert > Function) when building your formula – use the Structure tab to check the validity at each stage, with red crosses marking problems that need fixing.

USE CONDITIONAL FORMATTING

Visualising your data can be tricky, which is where colour comes into play. And thanks to conditional formatting, you can colour your cells differently depending on their value to provide handy visual alerts. Select your cells in Excel, then click the Conditional Formatting button. You'll see several presets under Highlight Cell Rules, such as 'greater than' or 'less than' – set your figure and choose the colour to apply when the rule is met.

Alternatively select New Rule for more options using a set of rule-type templates. In Calc, you'll find similar options under Format > Conditional.

PRINT SUBSETS OF YOUR DATA

By default, both Excel and Calc only print the active worksheet – you can change this to print all worksheets or just the currently selected cells after choosing Print. You can also define a print area, which will become the default print selection for that document going forward: in Excel switch to the Page Layout tab on the Ribbon. Select the cells you wish to include, then click Print Area > Set Print Area (this is where you go to clear the print area later if necessary). In Calc, select your cells and head to Format > Print Ranges > Define. You can add other cell ranges to this list later via Print Ranges > Add or edit existing settings via View > Page Break Preview.

AUGMENTING CHARTS

If you've created a chart, and want to add more data to it, select the new data series (your old data, plus any additional data), then drag and drop it onto the chart. When you delete or amend existing data from your data series this is automatically updated on your chart. In Excel, you can move an embedded chart by right-clicking the chart, selecting Move Chart and choosing where to place it – either to a new sheet or as an object within an existing one.

SORT IT OUT

Re-order data in a sheet by selecting all the data (to ensure it all gets rearranged, not simply the column you plan to sort), then click Sort on the Data tab of the Excel Ribbon. Choose which column to sort on, what you're sorting

(cell values or formatting) and which order you're sorting in (A-Z or lowest to highest or Z-A). A Custom List option enables you to sort using specific criteria like days of the week (so Sunday comes first, then Monday, and so on). Calc offers a similar set of options via the Sort button – choose your column(s) under Sort Criteria, then use Options to define how they're sorted.

SUMMARISE YOUR DATA

Sometimes you want to produce reports using different subsets of data – this is where a Pivot Table or Chart comes in. You'll find the options you need on the Data tab of the Ribbon or under Insert > Pivot Table (Calc). It can take a little trial and error to understand exactly what's going on – visit www.excel-easy.com/data-analysis/pivot-tables.html for a beginner-friendly guide.

CONDITIONAL FORMULAS

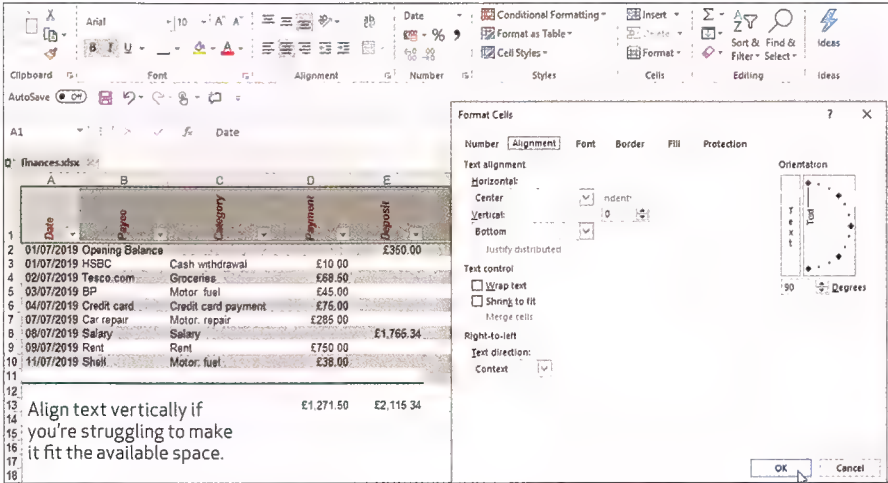
A conditional formula tests parts of a formula for specific conditions before

processing the calculation. For example, you can instruct your formula to either include or skip cells that have a number greater than, equal to or less than a specific figure.

There are two functions that can help here. SUMIF, which lets you apply a single condition to a calculation. Type =SUMIF(A1:A5, ">100"), for example, and the function will only add up those cells that contain a number greater than 100 in them. For more complicated conditional formulas, use the =IF command in conjunction with the Formula or Function Builder.

CELL FORMAT TRICKERY

Change the colour of a worksheet tab to make it more easily identifiable by right-clicking the tab and selecting 'Tab colour'. If you're struggling to get text to fit in the usual direction in a cell, rotate it: To do so in Excel, click Format on the Home tab and choose the Format Cells > Alignment tab. In Calc it's Format > Cells > Alignment tab.



10 spreadsheet shortcuts

All shortcuts work in both Excel and Calc except where stated

Shortcut	Points to
F4	Cycle through absolute/relative references
Alt-Enter	Start a new line in the current cell
Ctrl-1	Open the Format Cells dialog box
Ctrl-F2 (Calc) / Shift-F3 (Excel)	Insert function
Ctrl-D / Ctrl-R	Fill from cell above (both)/fill from cell to left (Excel only)
Ctrl-Shift-\$ / Ctrl-Shift-%	Format cell as currency or percentage
Alt=	Total up selected cells in cell below (Excel only)
Ctrl-Space / Shift-Space	Select entire column/row
Ctrl-Page Up/Page down	Move to previous/next worksheet
Ctrl-;	Insert current date

PowerPoint and Impress

PHOTOGRAPHIC BACKGROUNDS

You can embed a photo into a slide's background in PowerPoint by clicking Format Background on the Design tab. Select 'Picture or texture fill' then choose to insert a picture from a file, the clipboard or online. Once done, you can adjust its transparency, type (tiled or stretched) and position on-screen. Like what you see? Click 'Apply to All' to apply the background to all your slides.

Impress users should simply select Slide > Set Background Image to select a suitable image – it'll be stretched to fit by default. Another way to add the image is by right-clicking on a slide's existing background and choosing Properties. Select 'Bitmap', click 'Add/Import' to import your image, then use the controls to tweak its position and size – choose 'Custom position/size' and tick Scale to correct overstretch.

SPLIT INTO SECTIONS

One handy navigation aid for presenters on large PowerPoint slideshows is to split them into distinct sections. This doesn't simply mean creating section slides, but also inserting section dividers: click between two slides to bring up a red dividing line, then right-click and choose Add Section. Give your section a name and you're done. Repeat throughout your presentation – you can collapse section headers, plus use them to quickly rearrange the running order of your presentation via drag and drop.

INSERT SUMMARY SLIDES

Summary slides enable you to display multiple slides on a single slide as a summary, plus make them interactive so clicking a specific thumbnail will take you to the slide in question. In PowerPoint, click Zoom on the Insert tab

to create one – these can be a summary of the entire presentation, a specified section or a group of one or more selected slides from your presentation. Just make your choice and the slide will be created.

In Impress, select the first slide you wish to appear in your summary, then choose Slide > Summary Slide. This creates a new (non-interactive, sadly) slide at the end of the presentation where all the titles from your selected slide to the last one in the deck are written as bullet points as a summary. If the option is greyed out, it's because your slides have no titles on them.

UNDO CROP

Cropping images is a great way of making them fit the available space without having to edit them outside your presentation tool. You'll find the option when you select a picture in PowerPoint on the Picture Format tab; In Impress, you simply need to right-click the image in question and choose Crop. Use the drag handles to select the part of the image you wish to keep. Your edits are non-destructive (but note our 'Shrink File Size' tip on the page opposite), which means if you do want to undo your crop, click Crop again, but this time expand the drag handles to restore the missing parts of the image.

IMPORT SLIDES

Copy a slide from another presentation by choosing the Insert > 'Slides from Files' > Find Presentation tab and open the source presentation. Select the slide to copy and click Insert. Or simply drag and drop across – note: the slide will retain its original formatting but will adhere to whichever aspect ratio you have set up in the new presentation. Use an existing layout to convert it to the look and feel of your new slideshow.

SMART PASTING

When pasting text, PowerPoint retains the formatting by default. To paste the text and use the destination formatting you need to expand the Paste button on the Home tab and choose Keep Text Only. Or, to speed things up, add the command to the Quick Access toolbar above the Ribbon – click the expand button to its right and choose More Commands – you'll find 'Paste and Keep Text' only under 'Commands not in the Ribbon'. In Impress, you can simply make use of the Ctrl-Alt-Shift-V shortcut to achieve the same; you can't assign custom keyboard shortcuts in PowerPoint, sadly.

CREATING TEMPLATES

If you frequently create slideshows of a certain type, save time by creating your own template. Head to the View tab on the Ribbon and click Slide Master to create the various layouts you'll use. At the top is your basic master – anything placed here will appear on all your layouts, so use this as a starting point to define fonts, colours, background styles and so on. Once done, move on to create the different layouts you need.

In Impress, you access the master slide via the main sidebar: expand Slide and click Master View. You're stuck with the pre-defined layouts – instead create separate Masters for all the different layouts you need. Once done, select File > Templates > Save As Template.

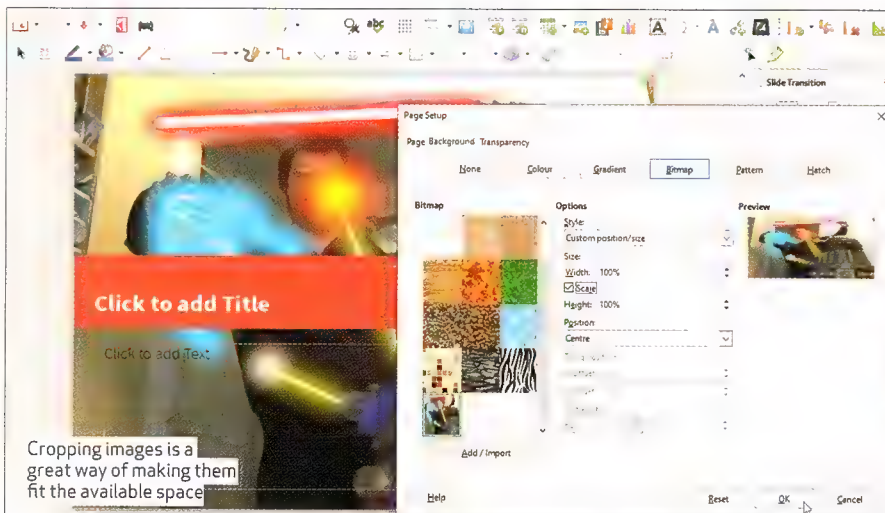
AUTOFIT OPTIONS

Typed too much text into a slide? Both PowerPoint and Impress will attempt to cram the text into the available space by automatically shrinking its font size. Switch this behaviour off in PowerPoint under the File > Options > Proofing > AutoCorrect Options > AutoFormat As You Type tab or apply it on a case-by-case basis using the AutoFit Options button that appears. Look out for options to split the text over two slides or convert the text box into two columns if it's massively overwritten.

AutoFit is less elegant in Impress – you right-click a text box, choose Text and tick 'Fit to frame' on a case-by-case basis. However, you can also define this at the Master Slide level to make it the default behaviour for any slides based on that Master.

REPLACE FONTS

Don't like a font you've used? The quickest way to get rid in PowerPoint is to choose Replace > Replace Fonts on the Ribbon's Home tab in the Editing



section. Pick the font you don't like and then choose a replacement. Click Replace to make the change across your entire presentation.

FINE-TUNE OBJECT POSITIONS

Use the arrow keys to nudge your text and graphics into position on your slide. Need even finer control? Hold [Ctrl] as you manoeuvre your elements around.

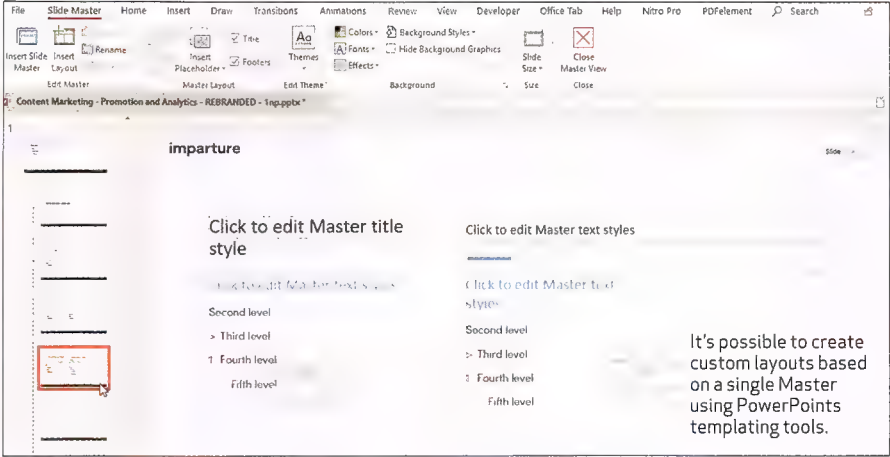
USE THE GUIDES

Gain additional help when moving objects with the help of guides. In Impress, first select View > Grid and Helplines > Display Grid to bring up a grid, and also View > Rulers to provide you with rulers from which you can place individual guides on the page. Snapping to guides is helpful for precise alignment, and you'll find plenty of options under View > Snap Guides for what elements can snap to: the grid, snap guides, object border, object points and/or page margins.

Things are simpler in PowerPoint – just three tick boxes for Ruler, Gridlines and Guides on the View tab, then click the More button next to Show to control snap behaviour and to set the size of the grid. If nothing else, leave the 'Display smart guides when shapes are aligned' box ticked to make it easy to arrange items around other objects.

PREVIEW SLIDESHOW EFFECTS

Take a peek at how your presentation is coming together in Presenter view by holding Alt as you click From Beginning or From Current Slide on the Slide Show tab in PowerPoint. No such presenter view exists in Impress, but you can run the slideshow within the main Impress window instead of full screen by choosing Slide Show > Slide



Show Settings and selecting 'In a window' under Presentation Mode.

PRINT HANDOUTS

Export slides to Word to create handouts in PowerPoint by choosing File > Export > Create Handouts, choose what to send and the format to use, and click OK. In Impress, you will find everything you need to print out handouts within the program itself – View > Handout Master is where you can tweak the master template, then simply choose File > Print and select Handouts from the Document drop-down menu.

FIX IMAGE ASPECT RATIO

Some images may have the incorrect aspect ratio – fix this in PowerPoint by making the Format Pane visible (click on the picture, switch to the Picture Format tab on the Ribbon). Select the size button and change one of the scales – if 'lock aspect ratio' is ticked, it should automatically fix this. If you need to, you can then re-crop pictures to fit the new aspect ratio so long as you're confident

the key information is still shown.

SHRINK FILE SIZE

Image-hungry presentations can soon start to swell in size. Rein them in by optimising the images. In Impress, you can do this via Tools > 'Minimise Presentation...'. Just follow the wizard to set the appropriate compression levels to reduce file size while keeping the presentation of sufficient quality to meet your needs.

It's slightly more convoluted in Word: here, after saving a backup copy you need to select any picture, then switch to the 'Picture Tools | Format' tab on the Ribbon. Click 'Compress Pictures'. By default, only the current image is affected, so untick 'Apply only to this picture' to have image compression apply across the entire document. You can then set a specific resolution and decide whether you need to keep the cropped elements of images. Click 'OK' and save to drastically cut the size of your presentation. ■

10 slideshow shortcuts

All shortcuts work in both PowerPoint and Impress except where stated

Shortcut	Action
Ctrl-M	Create new slide
Ctrl-Shift-D	Duplicate selected slides (PowerPoint only)
Alt-Shift-left arrow / right arrow	Promote or demote content according to stylesheet
Ctrl-Enter	Move from title to text to the next slide's title
Ctrl-drag	Make a copy of the selected object
F2	Create text box (Impress only)
F5 / Shift-F5	Start from first slide / currently selected slide
B or . (period)	Display a black screen during a slide show (press any key to continue)
W or , (comma)	Display a white screen instead (press any key to continue)
Esc/Ctrl-Break/- (hyphen)	End slideshow

Stuart proudly shows off the finished build.



MOD MASTER PRO PC

How Australia's top PC modder Stuart Tonks built a stunning custom build for Western Digital and APC. Words by Stuart Tonks and Ben Mansill.

To celebrate the release of its WD Black SN750 NVMe M.2 SSD, Western Digital commissioned Australia's most highly regarded professional modder Stuart Tonks to create a very special one-off PC that looked incredible and had the gaming chops to match its high-end components. Stuart has earned a reputation as one of the world's best modders, having exhibited his work in many countries, winning many awards. His

professional approach has helped elevate modding into the mature art form it is today.

Through the following pages you can see how Stuart created the PC and realised his creative vision. We hope that you might be inspired to do a little of the same, even on a small scale any little custom touch on your PC makes it special and unique.

This build is a stunner, as you can see from the photos on these pages. Stuart has made this project a relatively

classic design, going for an elegant and classy look that is both high mod art, and a practical, powerful PC that could be used daily.

The showcased WD Black SN750 NVMe M.2 SSD is positioned outside the case, showing off its cool looks, and yet it is fully functional. Read on to discover how Stuart managed this feat. Elsewhere you will find the venerable APC logo, making this PC truly one of a kind and carrying branding of the most prestigious PC institutions!

"Stuart has made this project a relatively classic design, going for an elegant and classy look that is both high mod art, and a practical, powerful PC that could be used daily."

A few experiments were needed to find the right way to get this stunning look

The WD Black SN750 SSD mounted outside the case, and fully operational

What a beauty!



Stuart matched the WD SN750's unique surface design with the case itself.

THE BUILD BITS

- WD Black SN750 NVMe SSD 1TB
- WD Black HDD 4TB
- Asrock Z390 Phantom Gaming-ITX/AC
- Intel i5-9600K
- G.Skill Tridentz RGB 16GB 3200MHz
- Zotac RTX 2070 Mini
- Nzxt H200i AIO CPU cooler
- Nzxt Kraken X52
- Nzxt E500 case
- CableMod Sleeved Cables

STUART TONKS

See more of Stuart's modding craft at:

- www.facebook.com/ggflanparty/
- www.instagram.com/ggfevents/
- www.youtube.com/c/ggfevents

IT COULD BE YOURS

YOU HAVE THE OPPORTUNITY TO WIN THIS EXCEPTIONAL PC BUILT WITH GAMERS IN MIND

Western Digital generously approached APC at the outset of this project asking if we wanted to be involved, and to run a competition to give it away to one of our readers. That could be you! Western Digital loves the APC audience and knows that which ever one of you wins this it will be appreciated and treasured.

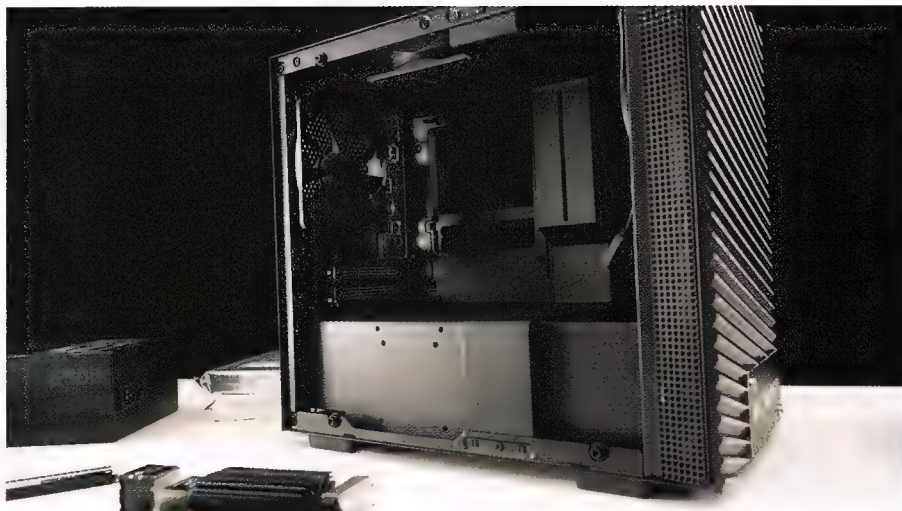
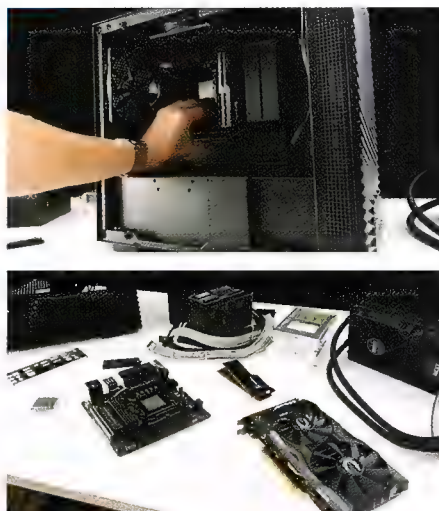
The PC is valued at over \$3,000, and that's for the parts alone which is not taking into account Stuart's time and talents in creating a PC that is beautiful and unique.

To enter, head to TechRadar, the home of APC online, and enter at www.techradar.com/news/apcmag

Closing date for entries is Sunday September 8th at 11:59pm. The winner will be chosen on Monday September 9th 2019 and notified by email and phone (if a phone number was provided on the entry form). Full terms and conditions at the URL above.



* COMPETITION OPEN TO AUSTRALIAN RESIDENTS ONLY. LAST ENTRIES ACCEPTED 8/9/19



1 PLANNING AND DESIGN

Stuart Tonks explains his ideas and how he made them a reality.

WESTERN DIGITAL

I've been working with Western Digital for a while now and have been using its SSDs, HDDs and NVMe drives since as long as I can remember. The company reached out to me to create a one of kind themed system that would be featured and given away in APC magazine. For me, this was a fantastic opportunity to talk about modding and the sometimes tricky challenges I face for the APC readers. I don't expect anyone to try and replicate this build – but there may be ideas and tips here that may spark your imagination to do something similar yourself, even on a small scale.

The theme for the build was to create and design a system based around Western Digital's new WD Black SN750 NVMe M.2 SSD. The performance of this SSD is top notch, so combining this SSD with other quality components meant it was a box that could look the goods, and deliver in-game. I wanted to go that little bit further and adapt the case into this theme and showcase the actual SSD in plain sight. As you can see, the whole front and right side of the chassis is a complete replica of the

tiny WD Black SN750 NVMe SSD's unique surface, colours and texture.

PRACTICALITY RULES

If you've followed my work, you probably know I'm a sucker for monstrous over the top custom water-cooled systems. For this project, I decided to tone it down a bit and think more about the practicality of a machine to be used regularly, rather than do a completely over the top mod that would be fragile and high maintenance.

As someone will eventually win this complete PC, I had a few challenges on hand. Firstly, I wanted to create a relatively small system that didn't take up much room – yet be a gaming powerhouse. It's 2019 and small form factor systems are becoming the norm. Not just that, but also silent systems are becoming more and more popular.

With those decisions out of the way, I had to toss up between either completely custom water-cooling the PC, or going with a more basic AIO setup. I went with the latter for a few reasons. Not everyone is comfortable with a custom water-cooled system.

The on-going maintenance, changing of parts and the thought of something leaking can be horrific to many. Plus having the system eventually being shipped to the winner, going with an air-cooled GPU and closed loop cooler means this PC will travel safely.

KEEP IT CLEAN

Then there was the whole appearance factor. PC modding of the years has grown significantly, and the creations from around the world are mind blowing. But in saying that, not everyone wants a spaceship or a monster-shaped PC sitting on their desk. I've also found after the many builds I've done that sometimes it's the less modified ones that grab the most attention.

Clean and sleek builds are among the most popular on my social media channels, so taking that clue this is the direction I went with here. It is a design that still preserves much of the clean aesthetics of the Nzxt chassis from the main viewing side, but from another angle completely transforms to take on the unique and great looking feel of the modded theme.

"The theme for the build was to create and design a system based around Western Digital's new WD Black SN750 NVMe M.2 SSD. The performance of this SSD is top notch, so combining this SSD with other quality components meant it was a box that could look the goods, and deliver in-game."

2 SELECTING THE PARTS

What went in, and why.

KEY COMPONENTS

1 Before we cover the completed build, let's check out some of the jaw-dropping hardware used. As mentioned early, I wanted to create a small system that was also relatively quiet when running.

But that wasn't all, I also wanted the system to pack a punch. So, inside it has Intel's latest 9th-gen i5 9600K processor, a Zotac RTX 2070 video card, a top of the line Asrock ITX motherboard and of course the WD Black 1TB SN750 NVMe SSD all has us off to a good start for a PC that can play any modern game as well as be a highly capable general-purpose machine. The star of the show and the whole reason for this build is the beautiful WD Black SN750 NVMe SSD. Not only does it look great, but temps are kept down with a stylish heatsink and you can really see now how the build came to life.

MOTHERBOARD

2 The Asrock Z390 Phantom Gaming ITX/AC is a mini powerhouse. There were three main reasons for choosing this motherboard. I was after a feature-packed board to make it a real delight for whoever won this system. Full AC wireless, Thunderbolt 3 Type-C and decent audio makes this one of the top Z390 ITX boards out there.

Secondly was how the board looked. For all my builds I focus very heavily on matching parts. If done right, it can really give that wow factor. You're probably starting to notice that everything in this build is either black or silver – which is exactly the look I was after. Lastly, I needed a motherboard with a rear M.2 slot. I'll cover more on this later, but it played a key role in modding the WD Black SN750 SSD externally to the rear side of the chassis.

GRAPHICS CARD

3 The Zotac RTX 2070 Mini was a perfect fit for the build. If you're not familiar with Zotac, it's known for small yet powerfully video cards – and the RTX 2070 Mini is a beast that compliments the WD Black SN750 SSD as a top performance part. The aesthetics of the card goes perfectly with the rest of the hardware and the single static white LED logo at the front compliments the CPU cooler and memory nicely. The card is also small,

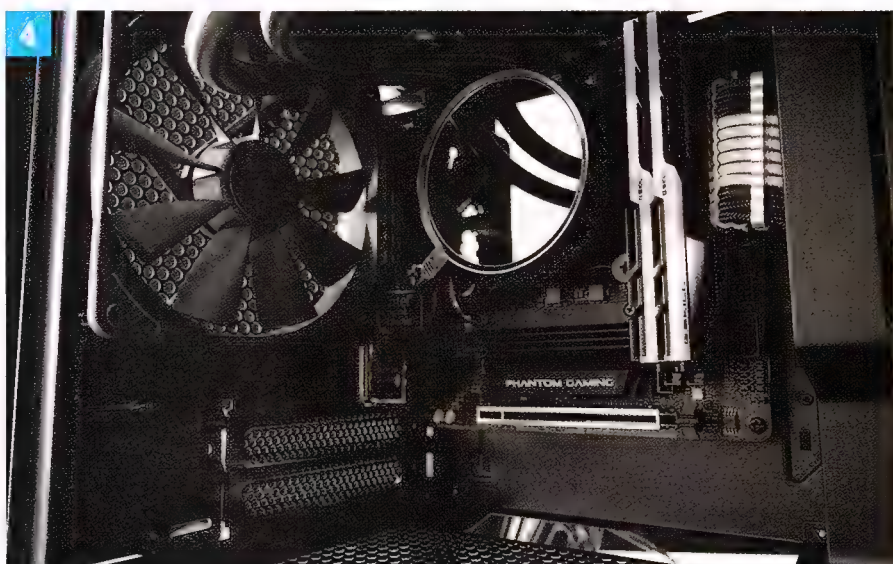
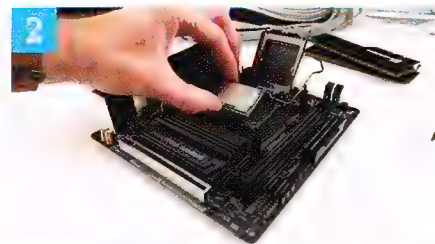
which ties in with everything else in the build. Going with the Mini, I knew I would have no issues fitting a powerful RTX 2070 in this build.

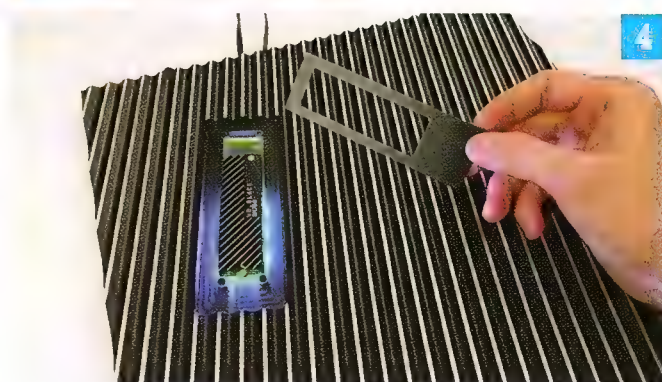
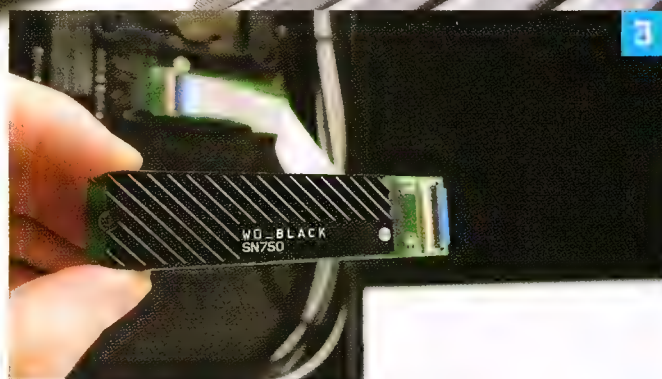
CASE AND COOLER

4 There were really two main components that made this build possible (apart from the WD Black SSD of course) and that was the motherboard I mentioned earlier, and the chassis. To pull my idea off, I needed a case that was 100% flat on the

front and right side, with the front intake taking air from the sides. I also needed this in an ITX form factor and with current up to date internals. The Nzxt H200i was a perfect choice and couldn't be happier with how it all came together. With the case being Nzxt, I then decided to go with an Nzxt Kraken X52 All in One cooler. These coolers perform very nicely and I love that gorgeous infinity mirror cooler design. Also sticking with Nzxt, I threw in one of its new E500 power supplies.

"The star of the show and the whole reason for this build is the beautiful WD Black SN750 NVMe SSD."





3 THE BUILD

Design and engineering challenges.

CREATING THE WD_BLACK SN750 SSD THEME

1 With the hardware out of the way, I then worked on implementing the mods into the build. I had one rough idea for the theme and that was to replicate the WD Black SN750 SSD's heatsink design on the case itself. Originally I was going to go with aluminium panels for the front and the side, but the added weight and mounting methods were not going to work. I looked high and low for off the shelf heatsinks that had a similar design to the WD Black SN750 SSD's unique heat spreader, but nothing existed. Going with CNC-cut Acetal (a high-performance engineering

polymer) was a much better choice as it was already black, easy to work with and much lighter.

Having the panels CNC cut exactly like the original WD Black SN750 SSD's heatsink was really the only way to get the exact finish I was after. As I don't own a CNC machine, I had a friend draw up the work in CAD to be then machines by my local plastics shop. Mounting the panels to the chassis was done via screws behind the Acetal panels.

GETTING THE LOOK RIGHT

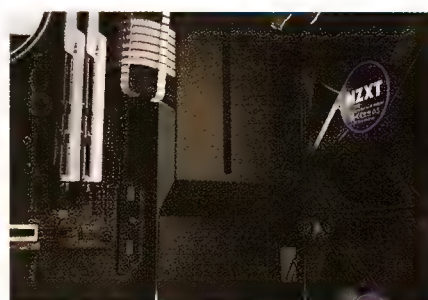
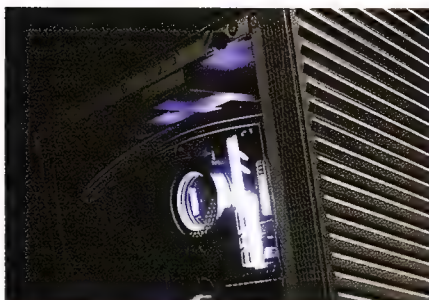
2 One last step to finish off the replica WD Black SN750 SSD panels was to create the silver edge as

seen on the top of the WD Black SN750 SSD's heatsink. If I went with aluminium for the panel material I could have painted them black, then sanded down the tops. But as I went with the Acetal material it made it bit more complex. I then planned on using strips of silver vinyl to create this effect but due to the finish and width of each piece, the strips simply would not stick. A silver paint pen did the trick with a long ruler to help keep the lines straight. I was quite hesitant on using this method at first and nearly ended up leaving the tops black.

Overall the contrast between the black Acetal and silver tops really compliments the build.



"Originally I was going to go with aluminium panels for the front and the side, but the added weight and mounting methods were not going to work."



"I was roughly able to work out where the WD Black SN750 SSD could be placed on the back side panel and where the cut out needed to be for the CNC machining work."

OUTSIDE THE BOX!

3 While I was brainstorming ideas for the replica panels I was always thinking of the end goal – being to show off the WD Black SN750 SSD and its beautiful look.

Being an M.2 SSD, they're usually one of the most hidden part in a typical PC, even though you sense the power on tap in constant use for gaming and other tasks, it usually remains unseen. Obviously this was not what we wanted here!

Over the last couple of years PCIe extensions cables for vertically mounted video cards have become popular, which made me wonder if such solution was possible to extend

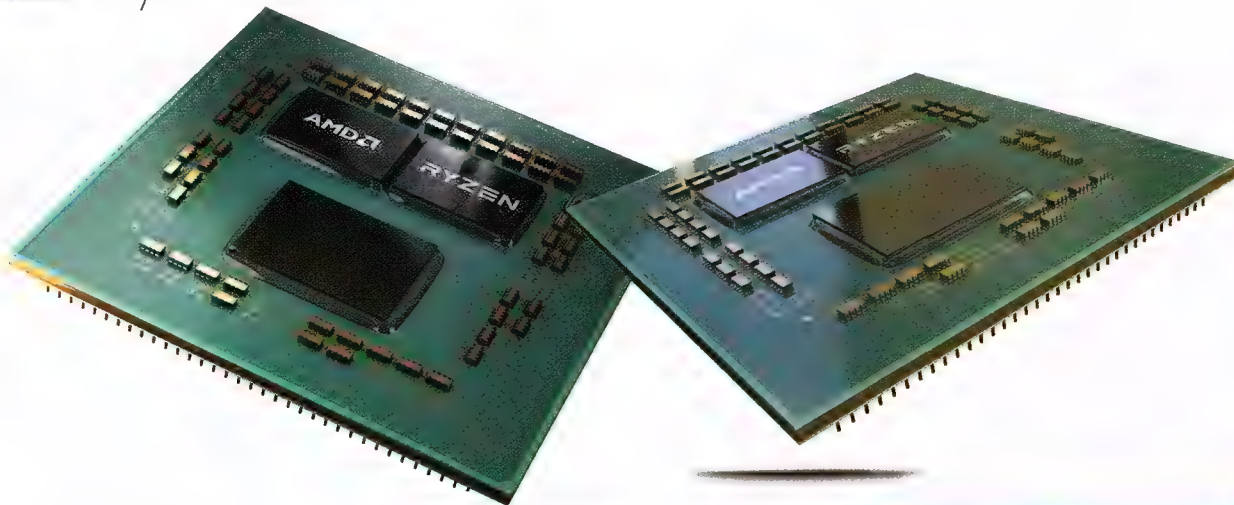
the M.2 slot. Funnily enough, such item existed on Ebay which extended a standard M.2 by 20cm via a flat ribbon cable. 20cm is not very much, so this was a crucial factor in choosing the motherboard for the build. As I knew some ITX boards have one M.2 slot on the rear, after some quick measurements I was roughly able to work out where the WD Black SN750 SSD could be placed on the back side panel and where the cut out needed to be for the CNC machining work.

FINISHING TOUCHES

4 As the M.2 extension cable came with its own daughter board, I

had to mount that first so the WD Black SN750 SSD could be slotted in. I managed to find some very small standoffs from an old video card cooler which would act as a platform for the SSD. As this elevated the SSD slightly I took advantage and added two RGB strips underneath the SSD to create a subtle glow. These strips are remote controlled and can be changed to any colour or mode.

The last step was to cover up the horrible green PCB from the Ebay M.2 extension. I considered painting it at first, but a simple plastic cover worked so much better and also makes for an easy operation if removing the SSD is needed. ■



System News

With Ryzen 3rd-gen CPUs having finally launched, Mark Williams offers some advice for those looking to purchase.

It's been over ten years since AMD has been able to beat Intel. And now, like then, it has made the CPU landscape very exciting for those looking to upgrade.

One of the amazing things about Ryzen since its launch two years ago is AMD's commitment to the AM4 socket. That commitment has created a wonderful ecosystem for those that bought in early to the AM4 platform, as it allows simple drop in upgrades to the latest processors without needing to rebuild your system around a new motherboard, but it also provides a plethora of choices for those new to the platform. Here are some things to keep in mind when looking to upgrade or switch to the new Ryzen CPUs.

Choose wisely. Currently, the 3600X and 3800X products are just over 20% more expensive than their very similarly specced 3600 and 3700X siblings, yet only provide about 5% more performance. Lean towards the latter two for best performance for your dollar.

Get a good aftermarket cooler! Instead of paying more for the likes of the 3600X or 3800X, spend your savings on a beefier cooler as Ryzen's are thermally constrained CPUs. Simply putting a better cooler on like an AIO water cooler will net you 100-200MHz extra in clock speeds without you having to do anything else thanks to AMD's smart inbuilt auto overclocking features.

Don't board the X570 hype train. The only real reason anyone should buy an X570-based motherboard to go with their new Ryzen is if it offers something current B450 or X470 motherboards don't. For the most part

that'll only be PCIe Gen 4.0 support. If you're not going to use a PCIe 4.0-capable SSD, save yourself the expense and go for a B450/X470 as you won't see any performance loss and your wallet will thank you. Just make sure where you buy it from can flash the latest BIOS on it for you, so it'll be compatible when you receive it.

If you're already on an A320/B350/B370/B450/X470 motherboard and want to drop in a 3rd-gen CPU, research if your particular motherboard supports the desired CPU on the manufacturer's website. If so, update to the latest BIOS revision before pulling your old CPU out and dropping the new one in. Keep an eye on BIOS update release notes for the next few months as AMD has been issuing new AGESA updates in rapid succession to fix bugs and performance issues post launch.

Finally, if you're using an older motherboard that doesn't have the strongest of VRMs, don't be afraid to drop in the beastly 3900X CPU (if it's supported). It won't be ideal as the VRMs could get stressed to their limits under high loads. Counter-intuitively, if you use the stock CPU cooler that comes in the box instead of going for a watercooler you may well find yourself some extra performance. Overstressed VRMs will cause the CPU to throttle back on speed so the motherboard doesn't cook itself, but with the included Wraith Prism cooler the CPU fan will push air all around the CPU socket including the VRMs, cooling them down and allowing your motherboard to pump out the full wattage this hungry CPU needs without overheating and throttling.

SHOP TALK

What are your top three tips for people considering an upgrade to the new Ryzen CPUs?

Jaya, Mwave:

"Consider the new X570 chipset to enable the full feature set on offer from the Ryzen 3000 series CPUs (PCIe 4.0, Gen 4 NVMe SSDs, enhanced bandwidth for robust I/O options).

If using an older chipset such as a B450 or X470, then spend time to investigate how to update your proposed motherboard's BIOS before purchase.

Check out reviews and benchmarks of the new Ryzen 3000 series that specifically show real world performance for apps or games that you plan to use."

John, TI Computers:

There are actually four key things to consider:

X570 is not the absolute option for Ryzen 3000 series. You can consider the rich variety of X570/X470/B450/A320 to suit your application if you are not looking to use PCIe 4.0 or heavy overclocking with Ryzen 9.

You may not need to go for the highest Ryzen. Thanks to the vast improvement in per core performance, the Ryzen 5, or even Ryzen 3 is competent enough to handle most workloads you may throw at them.

Considering not all CPUs come with integrated graphics, read the specs carefully before you buy.

Lastly and most importantly, rather than DIY, it will be wiser to consider finding a reliable shop to build the system for you. Shops can definitely help iron out all the complications and headaches while you enjoy the end results."

Market Snapshot

A sampling of PC systems available this month.



Mwave AMD Ryzen X570 Custom Gaming PC

\$2,504 [TINYURL.COM/APC471MWV](https://tinyurl.com/APC471MWV)

The new R5 3600X is a great CPU, but here it's paired with an equally new X570 chipset – yet with no PCIe 4.0 SSD to capitalise on the platform's most compelling current drawcard – you're paying a large premium for a feature that you can't use out of the box. If you plan on upgrading down the track however, this system begins to make more sense, with good water cooling, beefy VRMs and a higher wattage PSU, upgrading later to more powerful CPUs or GPUs will be no problem. This system is a good starter's build, but if you're looking to just buy a system and not mess around with it, you will find better deals elsewhere. Good system for an upgrader.

KEY SPECS: CPU: AMD Ryzen R5 3600X **COOLER:** Cooler Master MasterLiquid ML240R ARGB AIO **MOTHERBOARD:** MSI MPG X570 Gaming Plus **GRAPHICS:** MSI GeForce RTX 2070 Gaming Z 8GB **MEMORY:** Adata XPG Spectrix D60G 16GB 3200MHz DDR4 RGB **STORAGE:** Intel 660p 512GB M.2 SSD, Seagate 2TB BarraCuda HDD **POWER SUPPLY:** SilverStone Strider Gold S5 75F-GS V3 **CASE:** Phanteks Eclipse P300.

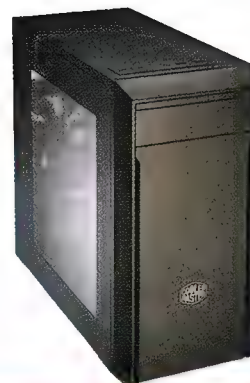


PC Case Gear Creation 2080 Ti Gaming System

\$5,499 [TINYURL.COM/APC471PCG](https://tinyurl.com/APC471PCG)

MSI has focused on content creators needs with this motherboard, and while it'll game and overclock just as well as most other boards they won't have such a high level of IO and expandability available to them. With seven PCIe expansion slots, out of the box support for up to four M.2 drives and a staggering 13 USB ports out the back, this thing is capable of workstation levels of productivity. If you crave high speed storage and lots of IO, this will not disappoint. Paired with the new 24-thread R9 3900X, this system will chew through any heavy workload in a snap. The RTX 2080 Ti is the cherry on top that also makes this system one of the best gaming machines around.

KEY SPECS: CPU: AMD Ryzen 9 3900X **COOLER:** Nzxt Kraken X52 240mm AIO **MOTHERBOARD:** MSI Prestige X570 Creation **GRAPHICS:** MSI GeForce RTX 2080 Ti Gaming X Trio 11GB **MEMORY:** Team T-Force Night Hawk RGB 3200MHz 16GB DDR4 **STORAGE:** Adata XPG SX8200 Pro M.2 SSD 1TB, Seagate Barracuda 2TB HDD **POWER SUPPLY:** Phanteks Revolt Pro 850W **CASE:** Phanteks Enthoo Evolv X.



TI Computers Winning Gaming AMD3600

\$1,595 [TINYURL.COM/APC471TIC](https://tinyurl.com/APC471TIC)

The R5 3600 CPU is the new mainstream price/performance king. With that at the centre of this system it's a great start and sets the tone for the rest of the build. Coupled with a B450 motherboard we save money over X570 with no performance losses to speak of. It just means no PCIe 4.0 is available, if that's of concern to you. Fast RAM and an NVMe SSD paired with a now superseded (and thus cheaper) RTX 2060 equal an astonishing amount of performance for not much coin. Thoroughly recommended for those wanting to game at 1080p at high frame rates.

KEY SPECS: CPU: AMD Ryzen 5 3600 **COOLER:** OEM **MOTHERBOARD:** Asus Prime B450M **GRAPHICS:** Asus 6G DDR6 GeForce RTX2060 **MEMORY:** Kingston Hyper X 16GB DDR4 3200MHz **STORAGE:** 500G NVMe M.2 SSD HDD, 2TB Seagate HDD **POWER SUPPLY:** Cooler Master Masterwatt 700W **CASE:** Cooler Master MasterBox Lite 3.

Scorptec Aorus RTX 2080 Gaming PC

\$2,999 [TINYURL.COM/APC471SCO](https://tinyurl.com/APC471SCO)

With Intel's CPU stack under attack on all fronts, this is one of the few Intel systems that makes sense at the moment. Intel's 9700K and 9900K still edge out Ryzen 3000 series in most games by a small percent, but if you do any form of productivity work Ryzen becomes the better choice. With that in mind, if you only game and are aiming at a 1440p 144hz+ experience, this is the machine for you. The components are top notch and will facilitate overclocking well. If you start gaming at resolutions beyond 1440p your framerates could drop below 100fps and the speed advantage the pricey Intel CPU has starts to become diminished. Keep this in mind to get your money's worth.

KEY SPECS: CPU: Intel Core i7 9700K **COOLER:** Thermaltake Water 3.0 240 ARGB Sync Edition **MOTHERBOARD:** Gigabyte Aorus Z390 Pro WIFI **GRAPHICS:** Gigabyte Windforce GeForce RTX 2080 8GB **MEMORY:** Corsair Vengeance LPX 16GB 3000MHz **STORAGE:** Samsung 970 EVO Plus 500GB M.2 SSD, Seagate BarraCuda 2TB HDD **POWER SUPPLY:** SilverStone Essential 650W **CASE:** Thermaltake Level 20 MT ARGB Black.



PC blueprints

The APC team's picks for a part-by-part perfect PC build to suit your budget.



PARTS LIST

PART		PRICE
CASE	BITFENIX NOVA TG	\$49
PSU	450W EVGA 450 BR 80+ BRONZE	\$113
MOBO	ASROCK B450M R4.0 AM4	\$95
CPU	AMD RYZEN 5 2600	\$229
GPU	GIGABYTE GEFORCE GTX 1660 6GB	\$369
RAM	8GB (2X 4GB) KINGSTON HYPERX FURY @ 2,666 Z NEW	\$89
SSD	120GB CRUCIAL BX500 2.5-INCH	\$29
HDD	1TB WD BLUE 3.5-INCH HDD	\$59
OS	UBUNTU DESKTOP LINUX 18.04 LTS 64-BIT	\$0
APPROXIMATE PRICE:		\$1,032

Some of the components in this budget build dropped in price of their own accord, and while we briefly dabbled with the idea of swapping over to an Intel processor, ultimately it wasn't worth the change. We did spot the BitFenix Nova TG case for just \$49 at CPL and MSY, which is considerably less than the \$75 most other shops sell it for, so that's a nice saving. The only change we did see fit to make was to switch from the 3000MHz Patriot Viper memory to a Kingston Fury kit. RAM pricing is in constant flux, and right now prices are relatively high. As such we've taken the decision to go with a slightly slower 2,666MHz kit, because sticking with 3,000MHz memory while prices are so high just added too much to the overall cost, and in balance the speed drop won't make a substantial difference to overall performance. We'd always encourage you to have a bit of a hunt around for good sales when deciding which memory to go for with a new build or upgrade.



PARTS LIST

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	\$149
PSU	550W COOLER MASTER MASTERWATT 550 80+ BRONZE NEW	\$79
MOBO	MSI B450-A PRO NEW	\$143
CPU	AMD RYZEN 7 2700	\$359
COOLER	COOLER MASTER MASTERLIQUID LITE 240 AIO	\$89
GPU	MSI GEFORCE RTX 2060 VENTUS 6GB	\$350
RAM	16GB (2X 8GB) CORSAIR VENGEANCE LPX @ 3,200MHZ NEW	\$139
SSD	250GB SAMSUNG 970 EVO PLUS M.2 PCIE	\$119
HDD	1TB WD BLUE 3.5-INCH HDD	\$59
OS	WINDOWS 10 HOME 64-BIT OEM	\$140
APPROXIMATE PRICE:		\$1,626

We managed to shave \$180 off our mid-range build this month. That's enough for a game or two (or seven, if Steam has a sale on). Making that saving came mainly from exchanging the Asus ROG Strix B450-F Gaming motherboard for a cheaper MSI board of similar features and capabilities, and moving to an MSI GTX 2060 graphics card instead of last month's more expensive Zotac equivalent.

Elsewhere component prices remain relatively stable, and, as with the other builds on these pages, the very low cost of storage helps a great deal with keeping costs under control. We only wish other segments of the industry could be as stable as this with pricing!



UPGRADE OF THE MONTH

3TB
Seagate BarraCuda Compute HDD
\$119, WWW.SEAGATE.COM

All right, we know – HDDs aren't sexy. This one is no exception; hold it in your hand, and it's little more than a heavy metal rectangle. But this HDD is particularly good value; a mere \$119 for three terabytes of storage, and we're using two of them in our turbo build. By comparison, if we wanted 6TB using the 2TB drives we were using previously, it would be an almost identical cost – but we have removed the extra hassle of setting up cables to a third drive. As such, we feel pretty comfortable naming this drive (the ST3000DM008 model) our Upgrade of the Month.

"Component prices remain relatively stable, and, as with the other builds on these pages, the very low cost of storage helps a great deal with keeping costs under control."

As you can probably tell just by glancing at the table, we made a lot of adjustments to our Turbo build this time around. Those adjustments have led to a saving of \$413. Not bad!

We decided to shift over to MSI with its RTX 2080 Ventus 8G. It's the same \$1,049 cost as the Asus Turbo RTX 2080 used in the last few builds, but has a better cooling solution. We mixed up our CPU cooling, too; it seems Cooler Master is the flavor of the month this issue, because its MasterLiquid ML360 enabled us to upgrade from 240mm to 360mm of radiator space – which can be fitted either to the top or the front of the Nzxt H700i – and saved us \$10 compared to the previous Kraken X52.

As expected, we also had to change out the PSU again, thanks to the constant price shifts, so we've gone with a reliable 850W model from Corsair this month. We also switched over to G.Skill RAM, using a 32GB kit from the Ripjaw series at 3,200MHz – a slight gain over last month's 3,000MHz memory for the same cost. Our final change was an upgrade to storage – no longer content with four terabytes, we're upgrading to two of Seagate's 3TB BarraCuda hard drives. We also considered swapping out the Gigabyte Aorus RGB M.2 drive for a Patriot VPN100 of the same size, but ultimately decided that the drop in speed wasn't worth the potential saving. ■

PARTS LIST

PART	PRICE
CASE	NZXT H700I \$219
PSU	850W CORSAIR TX-M SERIES 80+ GOLD NEW \$179
MOBO	ASUS PRIME X399-A NEW \$419
CPU	AMD THREADRIPPER 2950X \$830
COOLER	COOLER MASTER MASTERLIQUID ML360 RGB AIO NEW \$179
GPU	MSI GEFORCE RTX 2080 VENTUS 8G NEW \$1,049
RAM	32GB (2X 16GB) G.SKILL RIPJAWS @ 3,200MHZ NEW \$299
SSD	512GB GIGABYTE AORUS RGB M.2 NVME \$180
HDD	2X 3TB SEAGATE BARRACUDA COMPUTE NEW \$238
OS	WINDOWS 10 HOME 64-BIT OEM \$140

APPROXIMATE PRICE: \$3,732



Cooking up a gamer's delight

Take the most powerful mainstream graphics card around, add high-end hardware and a little RGB, and bake at 4K.

The build for this month is laser-focused on performance. We barely looked at the price tag during its construction, and didn't pay much heed to it when we did add it all up. We did, of course, have a pretty good idea what the best value components were, and what sort of ballpark we were going to end up playing in, but on the whole, money wasn't a factor. No, this machine was all about one thing: performance.

Specifically, we wanted to build a machine that wouldn't be constrained by bottlenecks. From the off, we wanted to give the Asus GeForce RTX 2080 Ti ROG Strix Gaming OC room to strut its stuff, and once you've got a serious bit of silicon like that in your machine, lots of the other

components fall into place. The big selling point of this graphics card, and the GPU that powers it, is that it makes the dream of 4K gaming a reality. Yes, even at the highest settings (although there's an important caveat when it comes to RTX titles: Even this card struggles to maintain 60fps at ultimate settings). Which means that while we generally don't include screen recommendations on these pages, we'll make an exception, and suggest that this rig is ideally paired with a quality 4K monitor.

So, over the next few pages, we show you how to build the sort of machine that gaming dreams are made of. Let's see what spending five times the cost of our budget build delivers in performance.

"We barely looked at the price tag during its construction, and didn't pay much heed to it when we did add it all up."

A FACTOR OF PERFORMANCE

As we've said, we're not particularly concerned about costs with this build, which gives us plenty of scope when it comes to picking the individual components. We wanted to make sure that we weren't holding the GPU back, so enlisted the help of the Core i9-9900K for the main grunt work, as the all-new Ryzen 3000-series CPUs are busy being benched in the Labs for review, so this is the go-to option in the mainstream space for performance junkies, for today at least. The Core i9-9900K was still locked under a waterblock in a previous build, unfortunately, so in order to use it here, we had to strip down that PC, which involved a fair amount of foul language, a reasonable number of spillages, plenty of scratches and bruises, and bright red hands at the end of the irksome procedure.

With the GPU and CPU selected, the choice of motherboard went to MSI's MPG Z390 Gaming Edge AC, because it was fresh in the office for review, and in terms of memory, we went for 32GB of HyperX Predator DDR4-3200 RAM – this should be more than enough for what we've got in mind for this build. Storage-wise, we've gone for a speedy 1TB 970 Evo M.2 drive, which is fast without being prohibitively expensive. We've paired that with 12TB of spinning platter storage, giving us plenty of space for work and play.

When you've got such great hardware beating away at the heart of the machine, it makes sense to show it off, which is why we turned to the new Define S2 Vision RGB from Fractal Design. This is a vibrant and spacious case, with plenty of support for cooling options, which is good, because we're also using the Corsair Hydro H115i Pro all-in-one. It's a hefty piece of cooling, but we had some interesting plans for how to install it. So, let's get building....

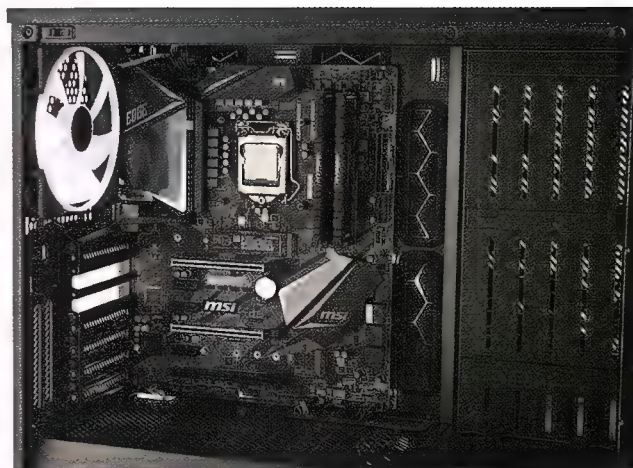


1 START WITH THE BASICS

To make sure that the core components were working, we slotted the CPU into the motherboard, connected the cooler, added the RAM and M.2 SSD, then connected the power, with it all on top of the mobo box. We hooked up a screen, then shorted the two pins on the front panel block that normally connect to the power button. This core was detected, and it booted without fuss. It's worth holding the cooler so air can flow freely through it. Once done, we disconnected the power supply and cooler, and started prepping the case. The smoked-glass side panels pop off once the thumbscrews have been removed, while a button at the top of the back panel releases the glass panel roof. We could remove the PSU shroud as well, but didn't feel this was necessary for what we had in mind.

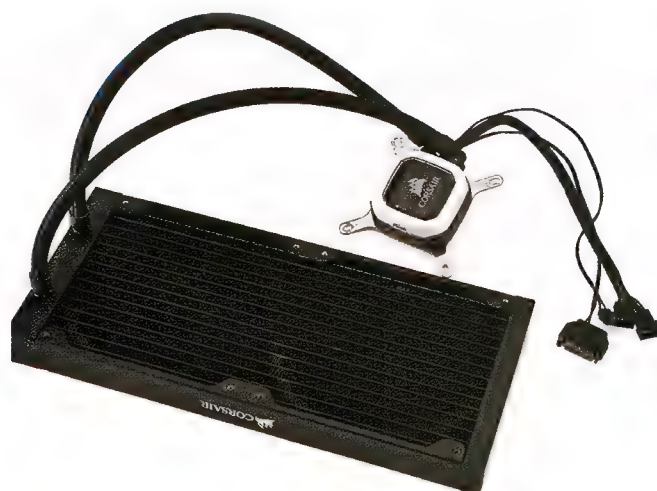
PARTS LIST

PART		STREET PRICE
CASE	FRAC TAL DESIGN DEFINE S2 VISION	\$399
MOTHERBOARD	MSI MPG Z390 GAMING EDGE AC ATX	\$289
CPU	INTEL CORE I9-9900K	\$769
CPU COOLER	CORSAIR HYDRO SERIES H115I PRO RGB 280MM	\$219
GPU	ASUS GEFORCE RTX 2080 TI ROG STRIX GAMING OC	\$1,879
MEMORY	HYPERX PREDATOR 32GB (2X16GB) DDR4-3200	\$338
PSU	CORSAIR HX1200I 1200W	\$349
OS STORAGE	SAMSUNG 970 EVO 1TB	\$319
DATA STORAGE	SEAGATE IRONWOLF 12TB	\$605
OS	WINDOWS 10 64-BIT OEM	\$140
TOTAL		\$5,306



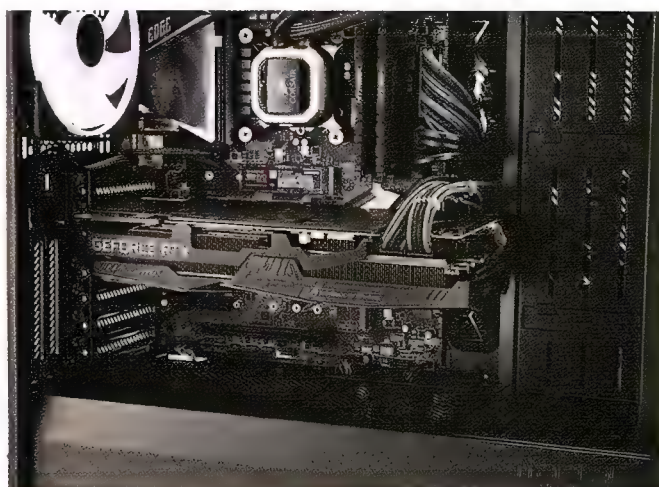
2 INSTALL THE MOTHERBOARD

The Define S2 Vision's main chamber offers little in the way of resistance to installing a motherboard, but the PSU shroud made things feel tight on the bottom edge. Maybe we should have removed it after all. Don't forget to slide the I/O plate into place before putting the motherboard in, and ensure the clips sit on top of the ports, not in them – which is what happened to us. Luckily, we spotted this before turning it on, so managed to avoid causing damage to the ports. With the motherboard and plate in place, it's simply a case of screwing in the eight screws that hold the board in position. We don't usually connect the case cables at this stage, but things were so tight at the bottom of the case that we felt we needed to do so here before adding even more cables to the mix.



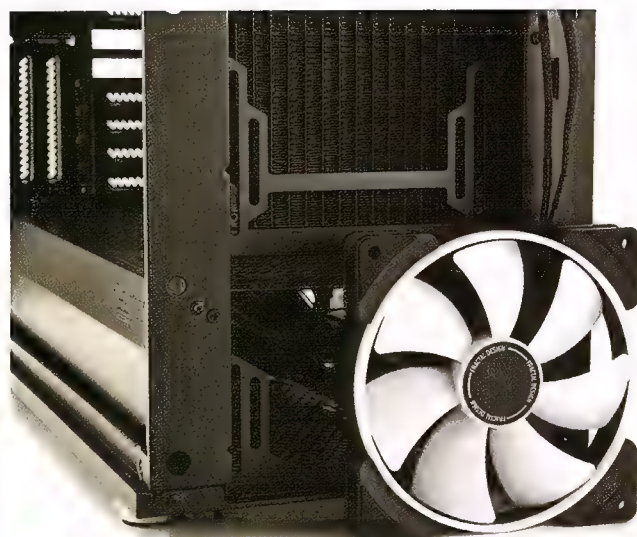
3 PLAN TO BE COOL

The Define S2 Vision supports a variety of cooling solutions, so we were spoiled for choice when mounting the Corsair H115i Pro. Its radiator is big, as it supports twin 140mm fans, and working out the best place to hold it was tricky. One option was to mount it facing outward on the right of the mobo tray, but that didn't provide optimal airflow. Another option was to install it in the roof, but we found it a bit too close to our memory sticks for comfort. Our solution was to place the radiator behind the fans at the front. One problem was that we couldn't install all three fans and the radiator, but it still provided sufficient airflow, especially with the rear fan drawing air across the mobo and components. We had to remove the existing fans from the radiator first – easily done.



5 LIGHT AND POWER

We'd already removed the two graphics card blanking plates, but if you haven't, do so now. Slide the card into the top expansion slot, and make sure the retention clip flicks into place as it hits the bottom. Secure it in place with the thumbscrews. Installing the PSU is trickier, which again had us wondering if we should have removed the shroud. This is a modular PSU, so connect the cables you need before installing; adding more after involves trying to plug in cables by touch alone. If you've got a similar loadout as we have, a single drive power cable, two PCIe cables, and the 12V CPU connectors are all that's needed. Screw the bracket on to your PSU, slide it in, and hold it in place with the thumbscrews. Feed the cables as best you can to where they're needed.



4 AN EXTRA PAIR

Trying to hold a radiator in place while screwing a fan into that radiator is tricky without an extra pair of hands. Actually, it was only a problem for the first screw, as after that, we could subtly move the radiator, or fan, or both, to make sure everything lined up. Connect the top-left screw first, then bottom-right, top-right, before finishing with bottom-left. Once the second fan was installed, we could look at the wiring. The fans in the Define S2 Vision are all PWM fans, so we could plug the front two into the controller for the H115i Pro. We didn't need the controller installed by default in the back of the case – it was easy to remove, and meant there were fewer cables to deal with. All these fans are ARGB units, so we installed the Adjust R1 controller, giving access to lots of fancy light patterns.



6 NEAT AND TIDY

The last item to install is the hard drive. There are three caddies; for cable management reasons, we went for the bottom one. Cable management isn't much fun here, as there isn't a lot of room. We like wrapped columns of cables, but the space available meant they needed to be flattened. We stripped away as many cables as we could, but there are still a lot to take care of, as the front panel has USB 3.0 type-A and type-C ports, as well as a couple of USB 2.0 ports, and the audio cables. We could have spent more time sorting out the cabling, but the ARGB connector came undone surprisingly easily when moving things around – there are only so many times you can open up the case again because the lights aren't working correctly before you lose the plot.



1 We could have installed the all-in-one's radiator in a few positions, but it worked well at the front of the case. Under load, we saw the temperatures rise to around 60 C, which isn't too bad. We had the option to attach the original fans behind the radiator as well, but didn't feel the need to without overclocking.

2 The PSU shroud at the bottom of the case produces a neat final build, but it does make for some frustrating times when actually piecing it together, particularly when it comes to attaching the front panel cables at the bottom of the motherboard. You can remove this shroud at the start of the build for an easier life.

3 While we're happy with the cabling on this side of the build, the back of the machine isn't quite so pretty. The space behind the motherboard tray is tight, and routing all the cables neatly felt like a Herculean task.

Power to spare

We may not have been concerned about the cost of this rig when we were piecing it together, but now it's whirring away, that \$5,300 certainly makes its presence felt. At five times the price of this month's budget, an obvious question would be: Are you getting five times the performance? The short answer is yes, the longer answer is that it depends on what you're doing. Or more importantly, how you're doing it. We've benchmarked our budget star at 1080p, and played games at 720p to see if it can actually game, while this machine struts its stuff at full 4K, with everything turned up as

high as it will go. It's hardly a fair comparison.

Some more relevant figures are born out of comparing this machine to the 4K zero-point, which we built just over a year ago. The zero-point cost a bit more than this rig when it was pieced together, but you may be able to pick up the parts for less today. Still, it's stood the test of time well – something that tends to be true at the top of the hardware pile (far more than at the budget end).

The key takeaway is that while we've had plenty of impressive advances over the last year, the same sort of money still nets you the kind of machine that

dreams are made of. You're looking at a machine that can handle the best games around with ease, and produce the kind of experiences that games developers want you to enjoy. It isn't all flawless, though, and *Tom Clancy's Ghost Recon: Wildlands* continues to be a thorn in the 2080 Ti's side, keeping it off the magical 60fps mark at the highest settings – if you want silky smooth performance, you have to fiddle with settings. That's also true if you want to strut your stuff with any ray-tracing titles. They still look better than anything you could produce with a more mainstream machine, but it's a bit galling to drop this much cash on a rig and not just be able to play it smoothly at the highest settings.

As ever at this stage in the build, we have to ask if there's anything we would change if we were to embark on such a system again, and the answer is more emphatic than it usually is: No, not really. The case was a challenge to work with, but this was partly due to the fact that we didn't remove the PSU shroud at the beginning; if we had, the chassis would have felt much more open to work in. It would have been nice to have a few more options with the cable management in the rear, but not enough to make us want to use another case. Ultimately, we were happy with the build and how the final machine looked. It's not a bad performer either. ■

BENCHMARK RESULTS

	ZERO-POINT	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	2,178	2,016 (-7%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	3,136	3,560 (14%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	2,126	2,510 (18%)
RISE OF THE TOMB RAIDER (FPS)	68	84 (24%)
TOTAL WAR: WARHAMMER II (FPS)	42	57 (36%)
TOM CLANCY'S GHOST RECON: WILDLANDS (FPS)	38	49 (29%)
3DMARK: FIRE STRIKE (INDEX)	6,988	8,357 (20%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of an Intel Core i9-7900X, 32GB G.Skill RipJaws V series DDR4 @ 3,000, an MSI GeForce GTX 1080 Ti Gaming X, and a 512GB Samsung 960 Pro PCIe SSD. All tests performed at 4K at the highest graphical profile.

howto

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

GAMING

COMPATIBILITY ISSUE IN WINDOWS 10

An old game called Train Dispatcher doesn't work properly on my Windows 10 laptop - nothing happens when I click Permits or Trains. Yet it works perfectly on my Windows 10 desktop. Can you help please?

Gerald Gibson

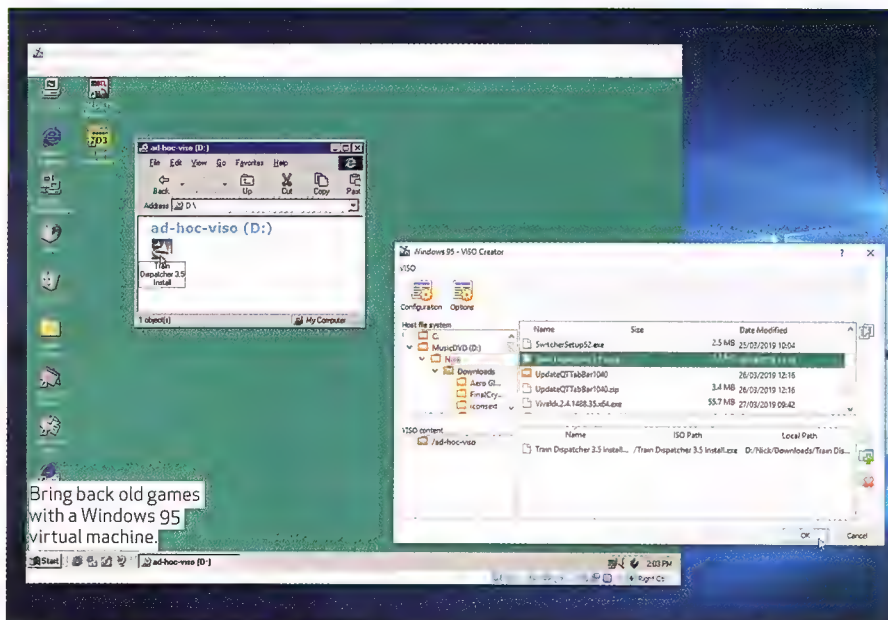
We were unable to replicate the issue on any of our Windows 10 machines, suggesting that it's an incredibly rare glitch. Instead, we offered Gerald the following workaround: set up a virtual machine running Windows 95. To do that, download and install VirtualBox (www.virtualbox.org) and then download the free Windows 95 virtual hard drive (https://archive.org/details/windows_95.vdi). Open VirtualBox and choose Machine > New. Name it Windows 95, set its type to 'Microsoft Windows' and its version to 'Windows 95' and allocate it 256MB of RAM. Choose 'Use an existing virtual hard disk file', click the button to open a new dialog box, then click Add to select Windows_95.vdi. Make sure it's highlighted and click Choose followed by Create. Select your virtual machine, and then click Start. Click 'Cancel' when prompted for a network password, then work through any other dialog boxes until the desktop appears. Choose Devices > Optical Drives > [drive letter] to install the program via CD; if you have a download file, choose Devices > Optical Drives > 'Create ad hoc VISO'. Locate the folder containing the installer using the upper panes, then drag the file into the bottom pane and click OK. Now open My Computer and double-click the CD drive where you'll find the file is available - just double-click it to run the installer.

Nick Peers

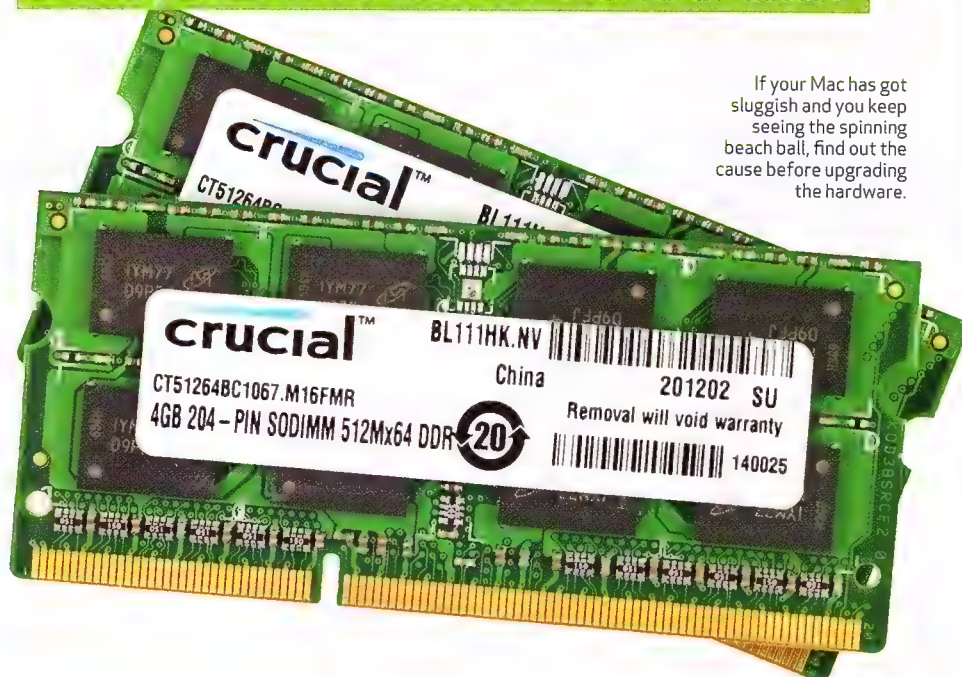
MAC

SLOW iMAC

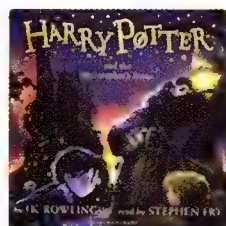
Since upgrading it, my iMac is slower and often shows a spinning beach ball, although it has 8GB of memory and a



"The best tools for discovering the causes of beach balls are Activity Monitor, and a log browser like Console for El Capitan or earlier, or Consolation for Sierra or later."



If your Mac has got sluggish and you keep seeing the spinning beach ball, find out the cause before upgrading the hardware.



Harry Potter And The Philo...
J. K. Rowling



Harry Potter And The Philosopher's Stone
J. K. Rowling

title Harry Potter And The Philosopher's Stone
author J. K. Rowling
release date
album artist J. K. Rowling
composer J. K. Rowling
genre Spoken & Audio
year 1997
track - of -
disc number - of 7
compilation Album is a compilation of songs by various artists
rating
play count -

You'll need to perform some post-ripping surgery to audiobooks in iTunes.

1TB hard disk with only 269GB used. Should I replace its hard drive with an SSD?

Andrew Frost

An SSD should make your iMac quicker, but that may not be worth the investment required. Before spending any money on it, work out why the beach balls are occurring, and eliminate them: that should make it more nimble again. The best tools for discovering the causes of beach balls are Activity Monitor, and a log browser like Console for El Capitan or earlier, or Consolation for Sierra or later.

Establish which process(es) are eating up CPU time when the beach ball appears, then, from the log, discover what they're struggling with. That could be an outdated app, a conflict, or a process crashing repeatedly. If Activity Monitor indicates a shortage of free memory, increasing that to the maximum of 16GB could give your Mac a new lease of life.

If you intend upgrading to High Sierra and beyond, an SSD would be valuable, as they're well-supported by Apple's new file system, APFS. But a 1TB SSD would be a substantial cost, and you might be better putting that towards a new iMac with its faster processor and much-improved graphics processor.

Howard Oakley

MEDIA

RIPPING AUDIOBOOK CDS

I have an extensive audiobook CD collection that I want to rip using iTunes so I can stream them to my iPad. I've heard conflicting advice about what to do - can you provide any guidance?

Marie Laurent

Audiobooks require a bit more work to file them correctly in iTunes. They're stored in your Music folder and considered music, so need rearranging manually. Start by optimising iTunes to rip spoken-word CDs: choose Edit > Preferences and click 'Import Settings...'. Either choose the Spoken Podcast setting under AAC Encoder or select MP3, choose Custom and set the Stereo Bit Rate to 64 kbps to keep file sizes down. Click 'OK' twice, pop in your CD and click Import CD, verify the import settings and click OK again. After the first disc has been ripped, repeat for all other discs in the same collection.

Once complete, right-click the audiobook title in Music view and choose Album Info, clicking Edit Items when prompted to edit multiple items. Switch to Options and change Media Kind to Audiobook. Import cover art via Artwork and go to Sorting to verify the correct author has been attributed before clicking OK. The only slight complication is if some (or all) of the chapters in an audiobook have been split into separate tracks on the CD. In this case you'll need to

select the individual tracks you want to combine before you rip the disc. To do that, select the tracks you want to combine (to make up one chapter, say), then select Join CD Tracks from the drop-down menu.

Catherine Ellis

WINDOWS

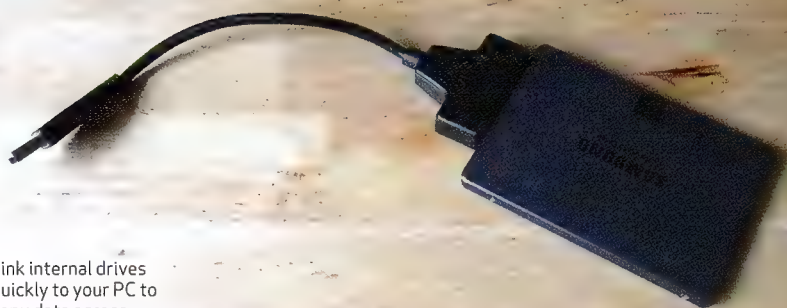
NO MORE FORCED UPDATES

After being plagued with issues by the most recent major Windows 10 update, how can poor Windows 10 Home users like myself avoid falling into traps laid by the next feature update?

Alan Fleet

We have excellent news for you, Alan: Microsoft has finally accepted it cannot simply push these major updates on to Windows 10 Home users. With the 1903 'May Update' and onwards, instead of it being forced on you you'll see a notification under Settings > Updates & Security > Windows Update inviting you to 'Download and install now', but only when you're ready. You'll only be forced to update when your current version reaches 'end of life' - around 18 months from its original release. Better still, once the May Update is in place Windows 10 Home users will also gain the ability to pause non-feature updates up to five times for seven days (so holding back for up to 35 days) before the update must be applied.

Rob Mead-Green



Link internal drives quickly to your PC to copy data across.

"The easiest option for a 2.5-inch drive would be a simple SATA III-to-USB cable (typically available for \$5-10)."



HARDWARE CLONING HELP

I need to clone my hard drive before it fails. I've purchased a new 1TB drive, but how do I attach it to my PC to be able to clone the old drive to it?

John Andrews

The easiest option for a 2.5-inch drive would be a simple SATA III-to-USB cable (typically available for \$5-10) – just connect it to the new drive and plug it into a spare port before cloning using Macrium Reflect Free. A 3.5-inch drive requires something beefier with its own independent power supply – a SATA docking station would do the trick here. These cost around \$30-40 and can be used with 2.5-inch and 3.5-inch drives.

Choose USB 3.0 for the fastest transfer rates.

Ian Sleightholm

WINDOWS LOCKED OUT

I can't log into Windows 10 with my Microsoft account, which has locked me out of my desktop. I messed up the login name and now it has a password of 'unknown'. I forgot the email address I registered on my Microsoft account and I get nowhere with the online account recovery process. Any way of getting around this?

'Doowop'

You'll need access to a second PC and the paid-for version of Lazesoft Recovery Suite (www.lazesoft.com/lazesoft-recovery-suite.html). The

latest version (4.3) can convert Microsoft account logins back to local user ones, making it easy to restore access to your PC. The downside is that this functionality requires a Professional Edition license, which costs US\$28 (around \$40). Once purchased, download and install the software on another PC and choose 'Burn CD/USB Disk' to create recovery media, then boot from this on your main PC. Choose the Password Recovery option from the main screen and follow the prompts to convert your account and regain access to your PC.

Nick Odantzi

HARDWARE FUSION DRIVE

I intend to replace my iMac, and am considering a Fusion Drive rather than a hard disk?

Liz Denton

Fusion Drives are an Apple-specific combination of a smaller SSD with a larger conventional hard disk. They attempt to deliver the speed of an SSD most of the time, at a cost which is little more than a hard disk.

To do that, macOS locks the two drives together using its Core Storage technology. This aims to keep your most active data – down to the block level, not necessarily whole files – on the SSD where they can be accessed most quickly, and less active ones on the hard disk with its far greater capacity. Fusion Drives used 128GB SSDs back in 2012, but now come in 24GB and 32GB versions.

Being two components, Fusion Drives will lose your data if just one part fails – much like a striped RAID array of two disks. As they're peculiar to Apple, repairs and replacements normally have to be done by an Apple service provider, and may be more costly. That said, many Mac users have been enjoying the benefits of Fusion Drives for five years now, and most seem very reliable and effective.

Currently their biggest limitation is that High Sierra's new file system, APFS, can't be used on them, and they have to be kept in the older Mac OS Extended format. Apple is expected to deliver an update to High Sierra which will enable APFS's use on Fusion Drives, although we don't know when.

If you can afford a large SSD, that's the best choice. But a Fusion Drive does deliver much better performance than a traditional hard disk, and is worth the extra cost.

Howard Oakley

MEDIA

IMPROVE YOUR SCANNED PHOTOS

I have a load of old photos to scan in – some of them are quite small. What's the best way to blow them up and preserve as much quality as possible?

Gregory Dahl

The following step-by-step guide is based around Dell's scanning tools, but other scanner makers provide similar controls – and in some cases, better ones too, particularly when adjusting lighting and colour balance.

Open your scanning tool and click Preview. Use the selection tool to crop around the photo – the scanner will automatically adjust its lighting settings to adapt to the photo, ensuring a better-quality scan.

While it's tempting to preserve sepia tints in older photos, choose the greyscale option from your scanner's colour settings to deliver a more vibrant scan – you can always tint it back again afterwards using an image editor such as Adobe Photoshop Elements.

The default 300 dpi setting preserves the original size of any scanned photo or document. For 2x3-inch photos, increase this to 600 dpi. Try 1,200 dpi or 900 dpi for passport-sized photos but be warned: they may come out blurry.

Some programs enable you to manually adjust lighting and colour balance to try and correct image issues at the scanning stage. Others – like our Dell scanning utility – merely offer basic fixes like toggling automatic settings on or off.

Catherine Ellis

WINDOWS

REINSTALL-PROOF PC

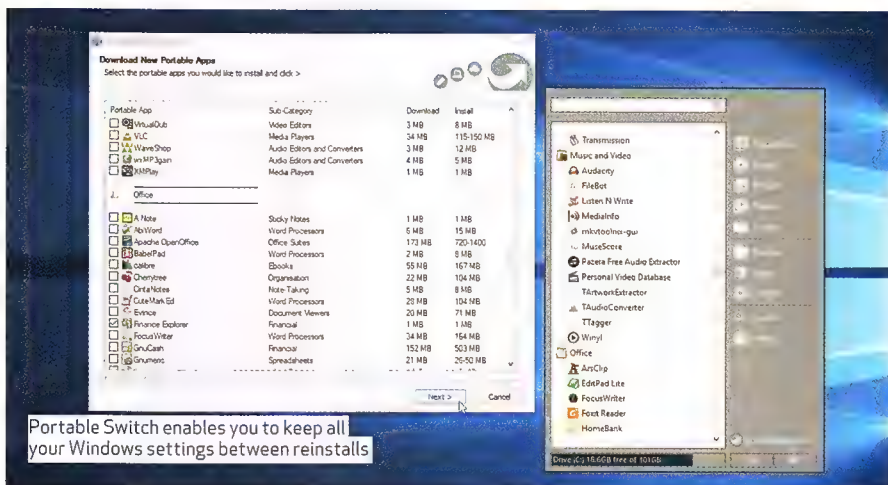
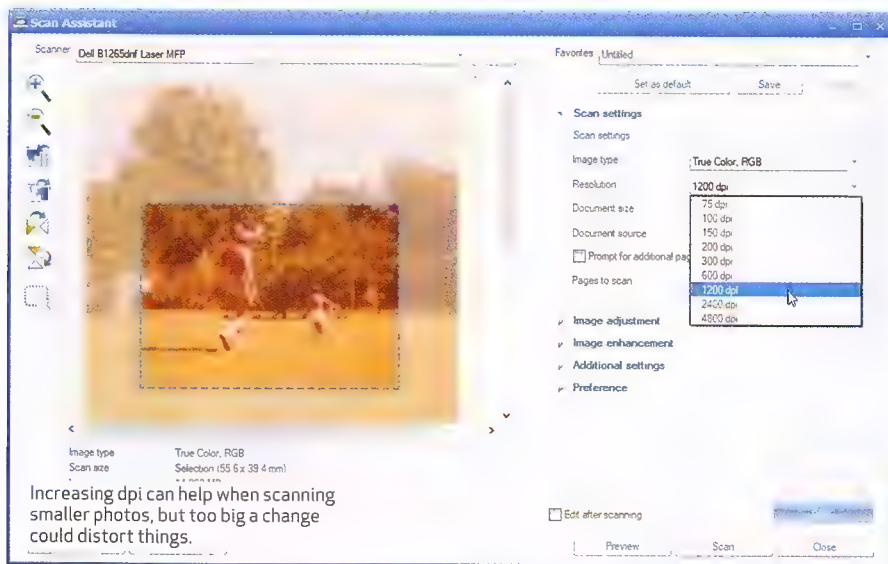
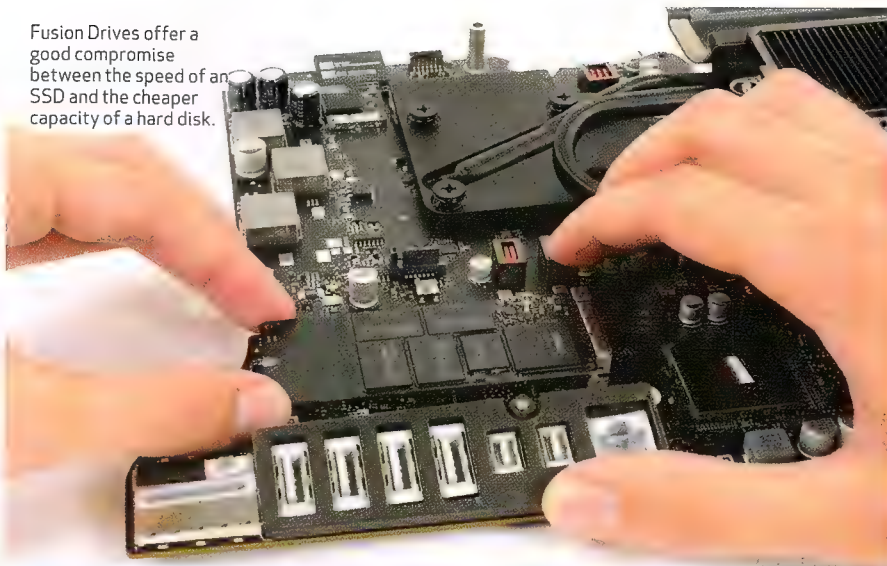
I've been forced to bite the bullet and start preparing to reinstall Windows 10 thanks to the fact I can't get Windows Update to work in any circumstances. How do I make this task easier in future?

Francis Pyke

Windows needs reinstalling every 18 months to two years thanks to frequent feature updates, which are effectively brand-new versions of Windows. You can reduce the pain by following our reinstall guides where we reveal such useful tips as moving your user folders to another drive or partition so the latest version of your data survives the reinstall procedure with no hassle.

After reinstalling open File Explorer to your user folder. Right-click Documents and choose the Properties > Location tab. Click 'Move' and select your newly created folder, then say 'Yes' when prompted

Fusion Drives offer a good compromise between the speed of an SSD and the cheaper capacity of a hard disk.



Portable Switch enables you to keep all your Windows settings between reinstalls

to move all your existing files to the new location. Repeat for the other user folders.

With your data moved, check out portable apps – these are programs that store everything they need (including your user settings) inside their own folder, making them easy to move, back up and restore.

Check your programs' websites for portable versions; if they don't exist, start your search for alternative apps on www.portableapps.com where you'll find office (LibreOffice), email (Thunderbird) and other programs are well represented

Carrie Marshall

Master Windows' Mail app

Whether you have a single email account or you're juggling multiple accounts, Windows 10's Mail app can help you to keep on top of your messages.

There is certainly a great deal to be said in favour of web-based email services such as Outlook.com, Gmail and the like, but that does not mean you should limit yourself to accessing your email account through your web browser. There are numerous reasons why you might want to consider using a desktop app to send and receive

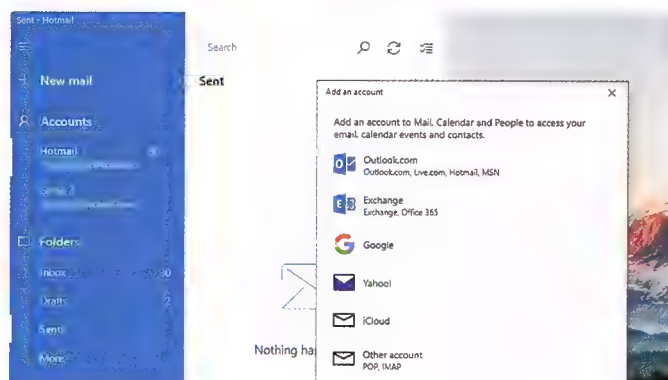
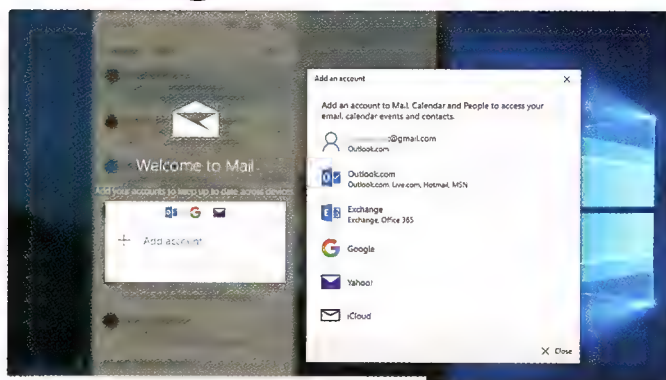
emails – just as you do on your phone – and it should come as little surprise that Windows 10 includes its own email client.

Called simply Mail, the app can handle any of the major webmail services such as Yahoo, iCloud and Gmail, and you can use it to work with a single email address or several. In fact, this is one of the reasons using an app

for email makes so much sense – it is so simple to access all of your emails in one place, without having to go forward emails between accounts.

So, if you've yet to delve into Mail, join us as we take you on a guided tour and reveal what this app can do for you.

Configure and use Windows 10 Mail

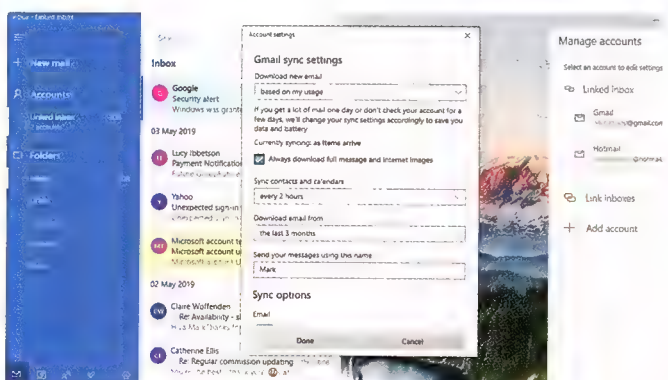
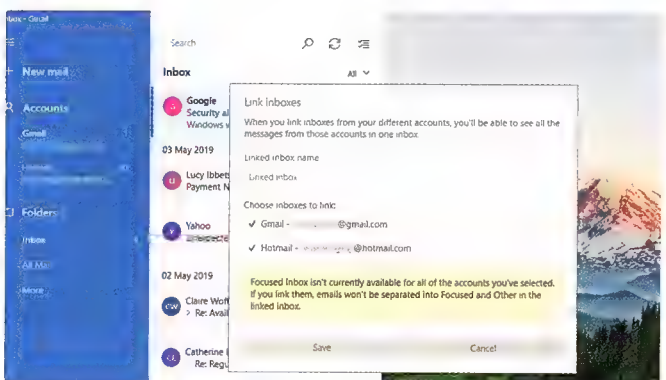


1 SETTING UP AN EMAIL ACCOUNT

The first time you launch Mail, you will be prompted to add one or more email accounts – click Add Account to get started. In the case of webmail accounts, things are very simple. Select the service you use and enter your email address and password when prompted. Use the Other Account option to add POP and IMAP accounts, and you'll be prompted to enter server details.

2 ADDING MORE ACCOUNTS

It's likely that you have more than one email account. One of the benefits of using the Mail app is that you can access them all in the same place, so it makes sense to add more than one account. If you decide to add more at a later time, you can click the Accounts label to the left-hand side of Mail, and then click Add account before entering the necessary details as before.



3 LINK YOUR INBOXES

By default, Mail keeps emails from different accounts separate – and you can flit between their inboxes using the menu in the left-hand pane. You may prefer to see everything in one place, however. To do this, click the Accounts link to the left and then 'Link inboxes' to the right. Select two or more email accounts, enter name for the combined inbox and click the Save button.

4 CHANGE MAILBOX SYNC SETTINGS

Click Accounts (left), then click an account on the right. As well as changing an account's label, you also can change how mail is synchronised. Click 'Change mailbox sync settings' and use the drop-down menus to choose how often Mail should check for new messages, and how far back it should download messages from your inbox. You can also sync your calendar and contacts.

SUBSCRIBE & GET APC FROM ONLY \$5.79 AN ISSUE!

12

ISSUES FOR ONLY \$79!

WHY SUBSCRIBE?

- Take advantage of our trial subscription offer of six issues for \$49 if you choose to auto-renew*
- Get 12 issues of Australia's favourite tech mag for only \$79!
- Save even more and get 24 issues for \$139 – that's just \$5.79 per issue!
- Free delivery of every issue straight to your door
- Free full-version software downloads with every issue

SAVE UP TO \$99.80!



**FREE DELIVERY TO YOUR HOME
OR OFFICE EACH MONTH**

HURRY

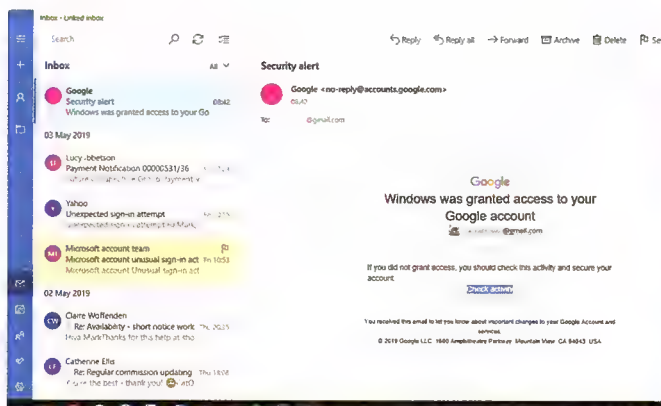
OFFER ENDS AUG 12TH 2019!

TWO EASY WAYS TO SUBSCRIBE TO APC MAGAZINE

VISIT WWW.TECHMAGS.COM.AU

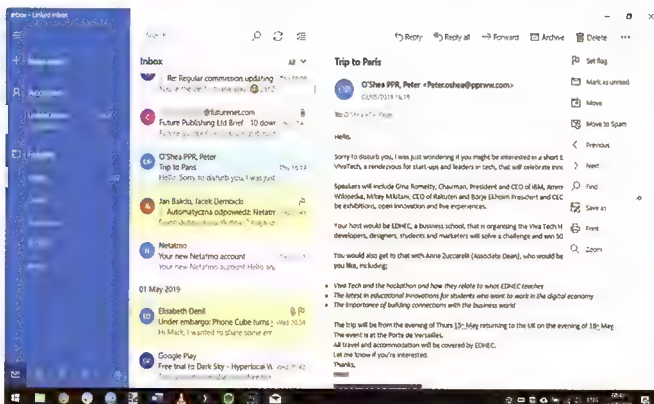
OR CALL (02) 8227 6486

TERMS & CONDITIONS: This offer expires August 11th 2019, and is available to subscribers within Australia only. Please allow 6-8 weeks for delivery of your first issue. For full terms and conditions, see: <http://techmags.com.au/style/images/FutureTC.pdf> Please see our privacy policy on page 3. *Six issues for \$49, then \$49 charged to your credit or debit card every six issues thereafter on auto-renewal.



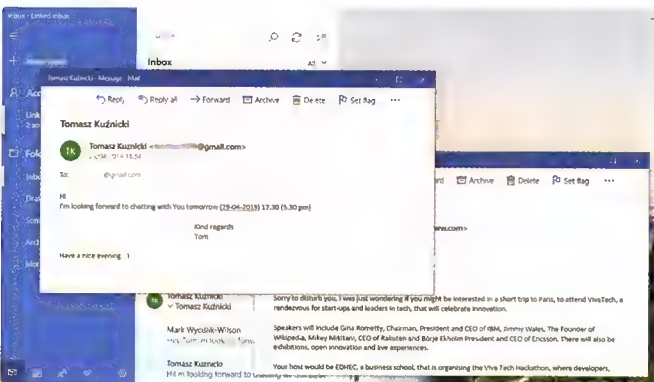
5 SHOW OR HIDE NAVIGATION BAR

The left-hand navigation bar is handy if you have multiple email accounts, or if you are constantly jumping between mail folders. You can declutter the interface, however, by clicking the three-line icon to the upper left of the app window. This collapses the pane to give you more space; clicking the icon again brings it back. Even with the menu collapsed, you can still navigate.



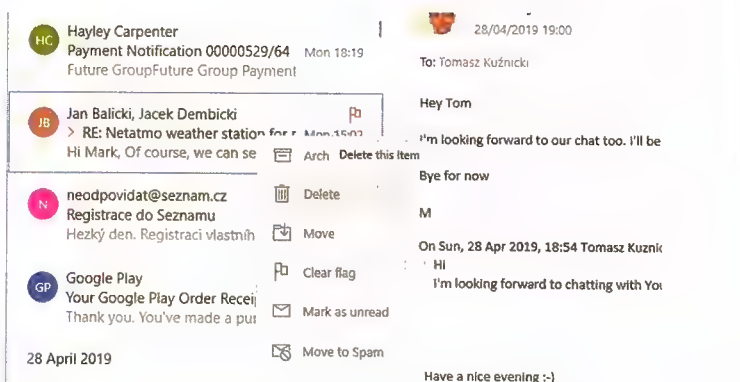
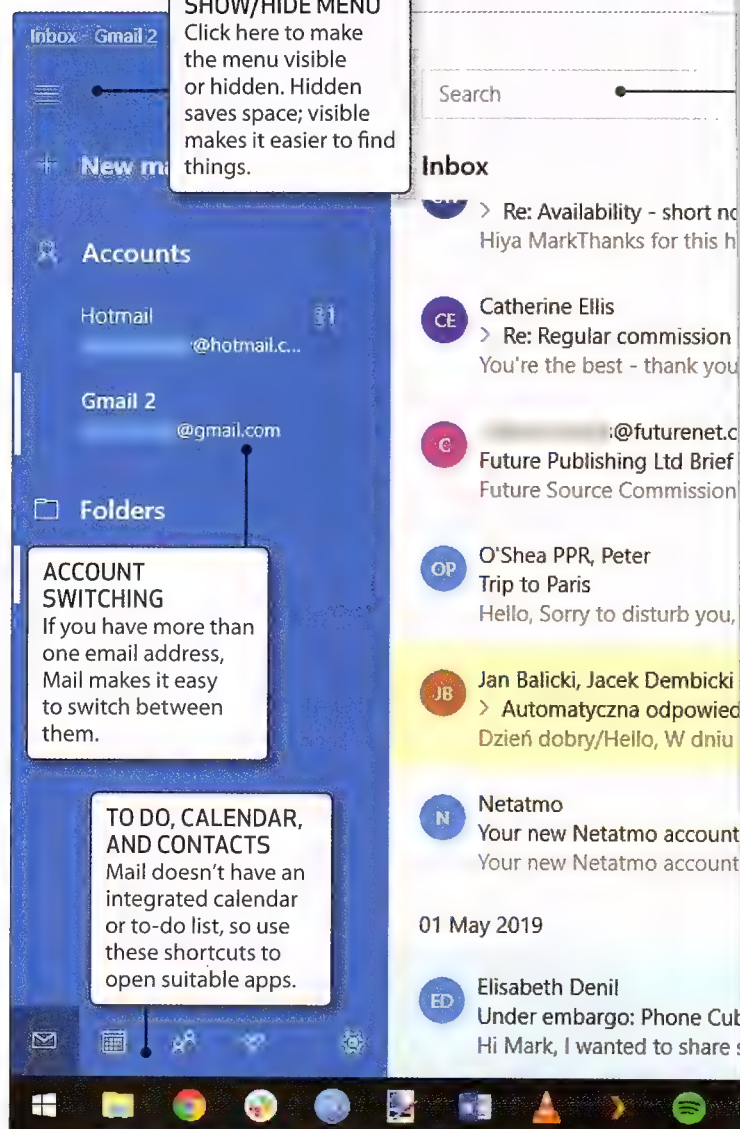
6 END, RECEIVE AND REPLY TO MAIL

Sending a new email is as simple as clicking 'New mail' in the left-hand pane. Dealing with emails you receive is also simple. As new mail arrives, click the relevant inbox and select a message to view in the preview pane on the right – unread messages are highlighted in bold. At the top of the preview pane are buttons for replying to messages, deleting them, flagging them and more.



7 OPENING MULTIPLE MESSAGES

There may be times when you want to see two emails side by side, but the preview pane only shows one message at a time. To get around this, select an email you want to view and click the 'Open message in new window' button, which appears to the right of the From field. Now choose another email and repeat the process before repositioning the windows as necessary.



8 EMAIL QUICK ACTIONS

There is no need to open an email to perform certain actions. If you hover your mouse over an email in the central inbox column, three pop-up icons appear. Use these to archive, delete or flag an email. This latter is handy if you want to be reminded about an email later. You can also right-click an email and use the context menu to perform other actions.

MAIL SEARCH

Use this to search in individual accounts, or across multiple accounts if you have opted to link all your email inboxes.

READING PANE

There's no need to open email in a new window – you can view its contents in a dedicated pane within Mail.

Jargon buster!

FOCUSED INBOX

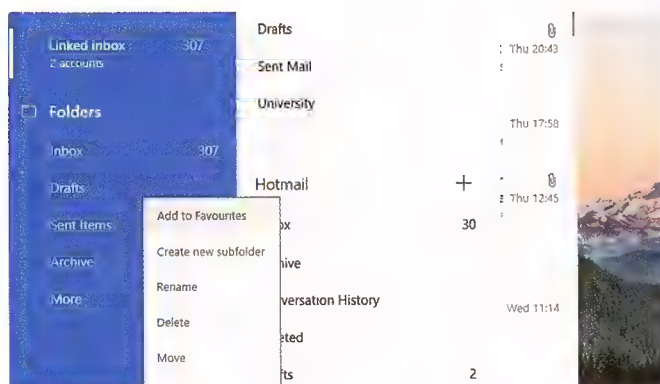
A feature of Mail, which organises your messages into two categories: Focused and Other. The messages deemed to be most important appear in the Focused section.

INBOX LINKING

An easy way to see mail from multiple accounts in one place. By linking email accounts, you can view all of your emails in a single inbox, saving you from having to spend time navigating around.

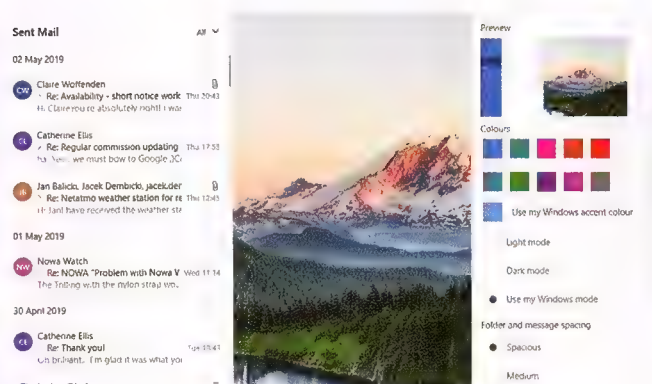
APC's best tip!

To hide email alerts, go to Settings > Notifications. Tick 'Apply to all accounts' and disable 'Show notifications in Action Centre'.



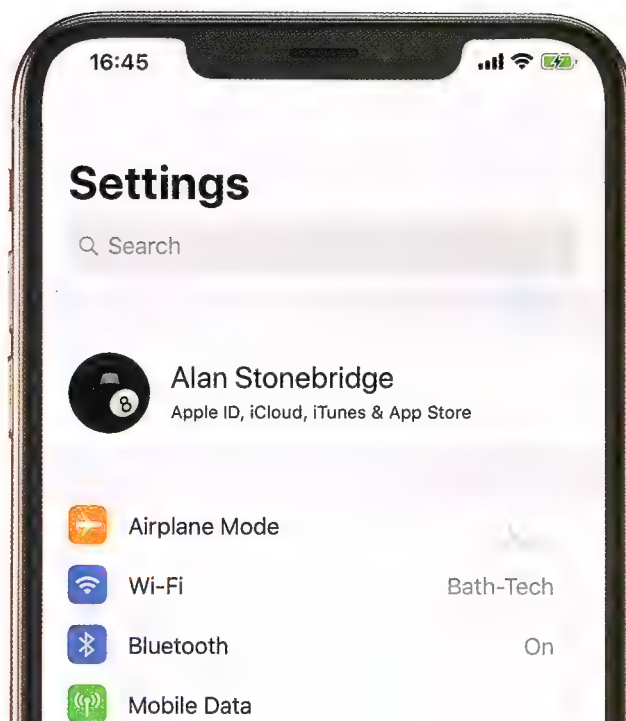
9 FAVOURITE FOLDERS

Folders are a great way to keep your inbox organised. Your inbox is likely divided into a number of folders by default, but you can create more. Click 'Folders' in the left-hand pane, then click the '+' button in the menu that appears. Enter a name for the folder you're creating and press Enter. To make a folder into a favourite, right-click it and select 'Add to Favourites'.



10 HANDY EMAIL OPTIONS

There are other settings for Mail you might want to explore. In Settings > Personalisation, for instance, you can change the colour and background image used in the app, while the Font section lets you tweak the appearance of email sent through each of your accounts. And in the Signature section you can customise the text that is added to the end of all your outgoing emails.



Make iOS behave better

Alan Stonebridge shares **nine options that everyone should at least investigate to improve their iOS experience.**

Your iPhone or iPad arrives with sensible settings that will suit most people, but it's wise to check the Settings app for behaviours you might want to tweak. From increasing the privacy of notifications on the Lock screen to improving familiar features

like Look Up and Siri, we'll help you get a running start by highlighting some of the most important settings to check out.

Unless your mobile data plan provides you with unlimited usage every month, you should definitely pay special attention to steps four and five

on the opposite page. That said, you may want to hold back on making changes until you are sure which apps are using too much data.

Your provider may have an app or a web-based service that breaks down overall data usage. However, you can keep a close watch on individual apps in iOS's Mobile Data settings menu, which lists the amount used by each one. Those figures are cumulative, and can be cleared by tapping Reset Statistics at the bottom of that page. If you intend to use this, we recommend setting a recurring alert in Reminders to prompt you to do so.

KEEP DIGGING!

The iTunes and App Stores are nicer to browse these days, with slick animation and videos that autoplay – these look great, but the latter can use even more of your mobile data.

Not all of our tips are for brand-new devices. If your current iPad or iPhone is running well except for its Home button's reliability, don't worry if you can't afford the money or downtime to get it fixed right now – there's a software workaround!



Sometimes you'll want to use Hey Siri to make life easier. On occasions when you'd rather your iOS device wasn't listening for the magic phrase though, place it face down.

How to

Adjust important settings.

< Settings Face ID & Passcode

ALLOW ACCESS WHEN LOCKED:

Today View

Notification Centre

Control Centre

Siri

Reply with Message

Home Control

1 PREVENT UNINVITED ACCESS

You may want to limit access to some features unless your device recognises you're in control. In Settings > Touch/Face ID & Passcode, look under 'Allow access when locked'. You won't want a stranger to control your HomeKit accessories!

< Music Mobile Data

Mobile Data

Use mobile data for updating your Library and loading artwork.

Streaming

High-Quality Streaming

Always stream music at the highest quality. This will use more mobile data and songs may take longer to start playing.

4 MOBILE DATA PERMISSION

Inspect the settings for apps that use the internet. Some offer fine control over how they use data. For example, see mobile data options in Settings > Music and Settings > iTunes & App Stores, and the Video Autoplay item in the latter.

< General Dictionary

✓ British English
Oxford Dictionary of English

✓ British English
Oxford Thesaurus of English

✓ American English
New Oxford American Dictionary

✓ American English
Oxford American Writer's Thesaurus

✓ Apple Dictionary

7 HIDDEN DICTIONARIES

Select some text in iOS and tap Look Up in the options bar that appears, then scroll down and tap Manage Dictionaries to download dictionaries and thesauri for use with this feature (you might prefer to do this while you're on Wi-Fi).

< Back Google Maps

ALLOW LOCATION ACCESS

Never

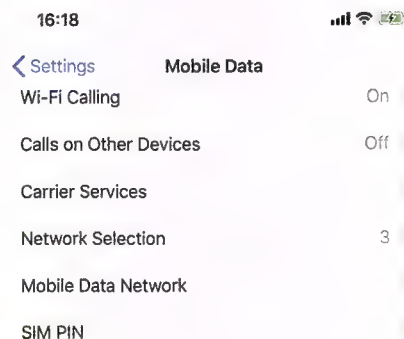
While Using the App

Always

App explanation: "To get navigation, traffic and public transport updates, and see info about places near you, choose Always Allow"

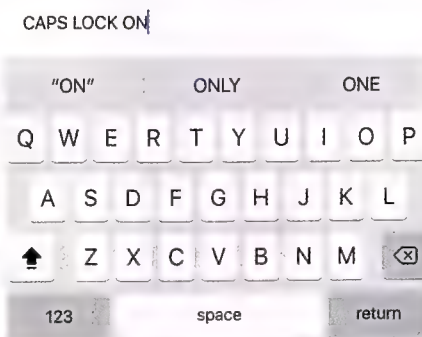
2 GUARD YOUR PRIVACY

Review whether apps can track your real-world position in Settings > Privacy > Location Services: always, never or only when you're using the app. One level up, check you haven't unduly granted access to other personal things, like your photos.



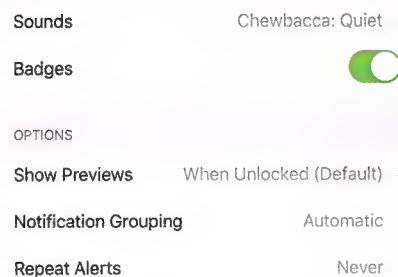
5 RESTRICT OTHER APPS

Not all apps offer fine control of mobile data usage. If you'd like to prevent others going online when not using Wi-Fi, scroll down to the list of apps in Settings > Mobile Data and turn off the switch next to any app that you want to restrict.



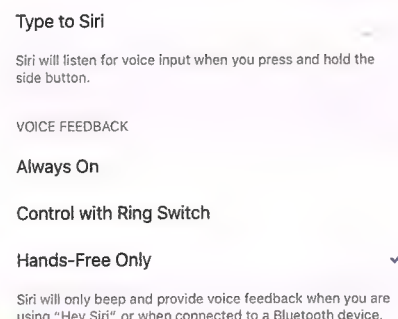
8 TWEAK THE KEYBOARD

Apple has a basic guide to items in Settings > General > Keyboard at bit.ly/mfioskbd. You may want to turn off auto-capitalisation/correction. Enable Caps Lock means you can double-tap the up cursor to type in capitals without holding that key.



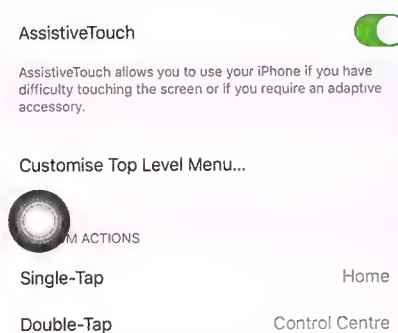
3 STOP INFO LEAKING OUT

In Settings > Notifications, set Show Previews to When Unlocked so detailed info isn't shown on the Lock screen until you use Touch/Face ID. If you prefer, limit this to specific apps in the list below; each has its own Show Previews setting.



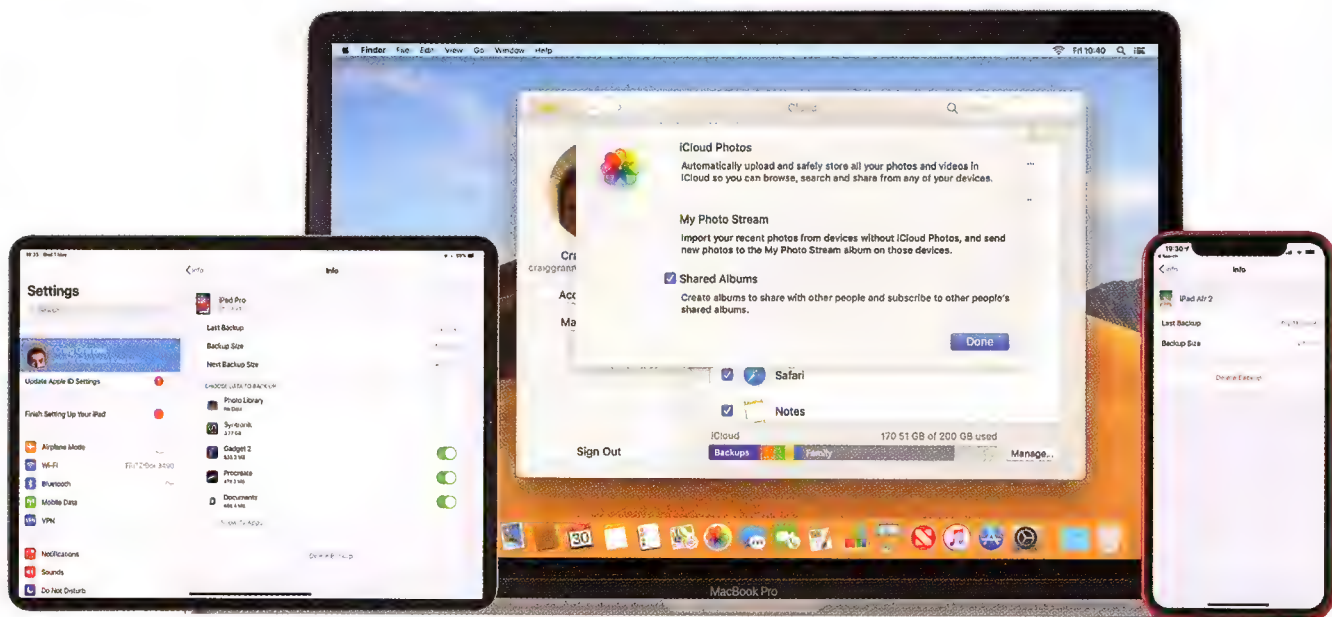
6 MAKE SIRI BEHAVE BETTER

Siri usually speaks no matter how you call upon it and whether it's set to take voice or typed input. To have it speak only if initiated with "Hey Siri"/from headphones, pick Hands-Free Only in Settings > General > Accessibility > Siri.



9 HOME BUTTON ISSUES?

If your old iPad's Home button is wearing out, use an on-screen fallback till you get the iPad fixed or replaced. Turn on AssistiveTouch in Settings > General > Accessibility. Set the single tap to Home, and check the other actions available. ■



Manage iCloud storage

Make the most of your iCloud gigabytes with these handy tips from expert Craig Grannell.

Cloud storage means total convenience. Content saved to iCloud is available on any device that's signed in to your account. It's a great way to store and access everything, from calendar data to getting at whatever is on your Mac's desktop by using the Files app on iOS.

Unfortunately, Apple only provides

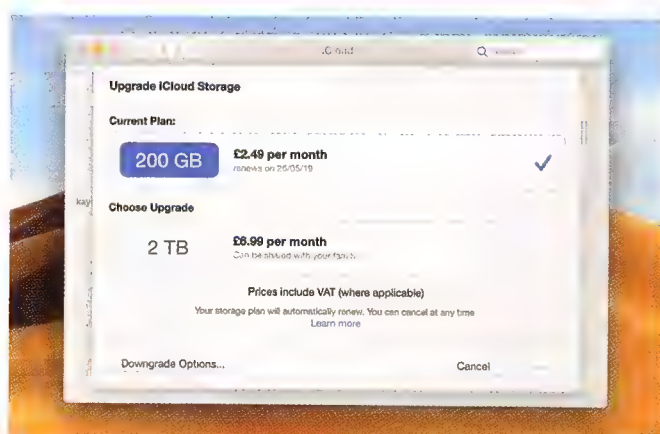
a miserly 5GB of space for free. Upping that to 50GB costs \$1.49 per month. 200GB and 2TB cost \$4.49 and \$14.99 per month respectively.

The problem is if you hit your limit, things will just stop working. iOS devices may no longer backup. Apps and documents will stop syncing data. Apple will, of course, suggest you throw more money its way.

However, there is an alternative to simply paying more. If you want to keep costs down but retain the advantages of iCloud, look at managing whatever space you have already. By making use of our tips, you can minimise what you spend without eradicating the benefits of using the system.

How to

Optimise iCloud storage.

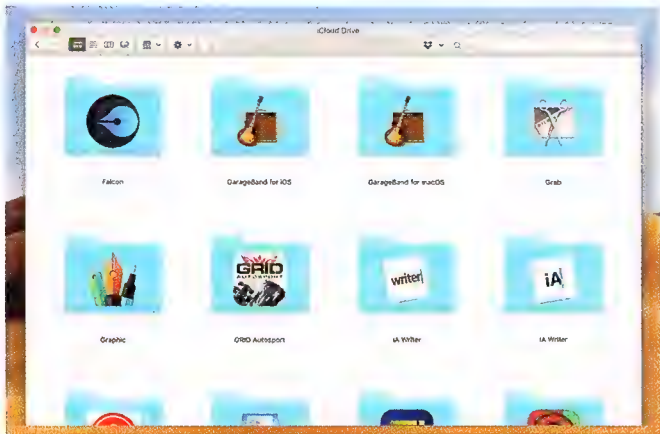


1 EXPLORE YOUR USAGE

In System Preferences, click iCloud. You'll see an overview of your account's limit and current usage. Click Manage and you get a more detailed breakdown of what's taking up space, so you can plan accordingly.

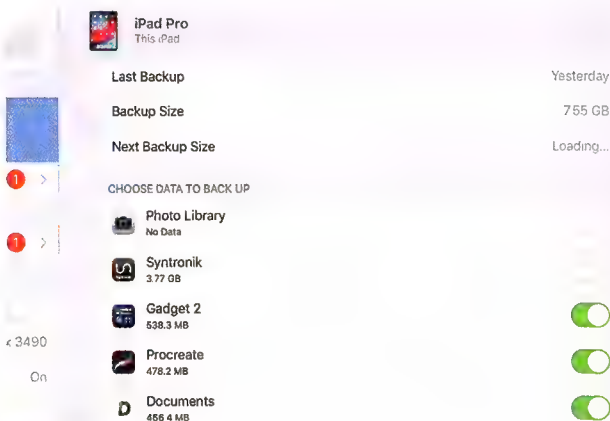
2 SWITCH YOUR PLAN

The quickest way to deal with a lack of iCloud space is to upgrade your plan – click Buy More Storage to do so. This is also where you go to downgrade – prior to that, ensure your Mac has enough space for your data.



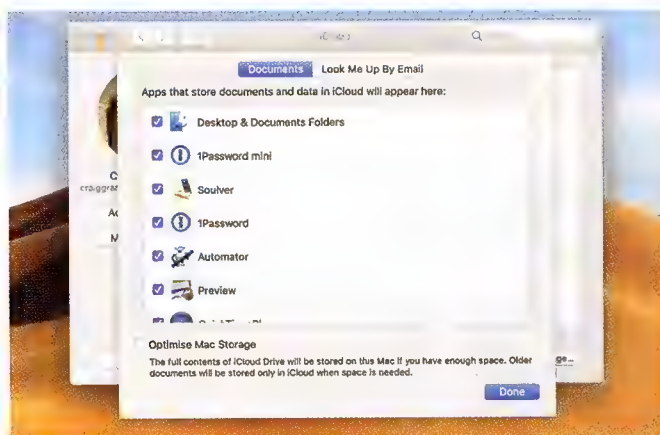
3 PRUNE APP FOLDERS

Mac and iOS apps often save to iCloud Drive. Select iCloud Drive in Finder's sidebar to view their dedicated folders there. If there are apps you no longer use, back up/archive those folders and remove them from iCloud Drive.



6 REFINE IOS BACKUPS

Tap the current device's backup to see its size and what data is being backed up. If there is data you don't need in iCloud (such as in book/magazine apps), turn it off – especially if you can restore it from elsewhere.



7 MINIMISE MAC ICLOUD USAGE

If you sync Desktop and Documents to iCloud, you can turn off that feature to save online space. Better: take care with what you put in those folders. Don't dump huge files on the desktop. Ensure big files are stored locally.

◀ Search

◀ Info

Info



iPad Air 2

Last Backup

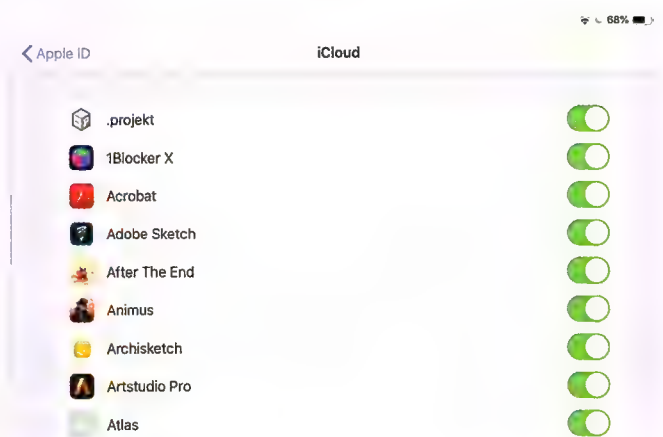
03/11/2018

Backup Size

5.7 GB

5 DELETE OLD BACKUPS

On iOS, go to Settings > [your name] > iCloud > Manage Storage > Backups to see a list of iOS device backups taking up iCloud space. Some may be redundant – and big! If so, delete them: tap an item and then Delete Backup.



6 USE LOCAL IOS STORAGE

If you use an iOS app that stores a lot of data solely on one device, and you unflinchingly back up that data elsewhere, consider turning off iCloud usage for that app in Settings > [your name] > iCloud (don't risk data loss, however).



8 REMOVE PHOTOS AND VIDEO

These media files take up a lot of space in iCloud, either in your iCloud Photos library or, if you don't use that, in iOS device backups. Pruning them can save a ton of space, but you must ensure you copy them to your Mac first. ■

Turning an old PC into a NAS

You don't need to pay through the nose for a new NAS, as Nathan Taylor explains.

If you've never owned or used a network attached storage device, there are two things you should know about them: a) they're awesome; and b) the commercial ones are basically just PCs running a specialised version of Linux. Their main advantage is their industrial design: the ease of installing and removing hard drives. But you pay quite a bit for that industrial design, and many commercial NASs have their flaws.

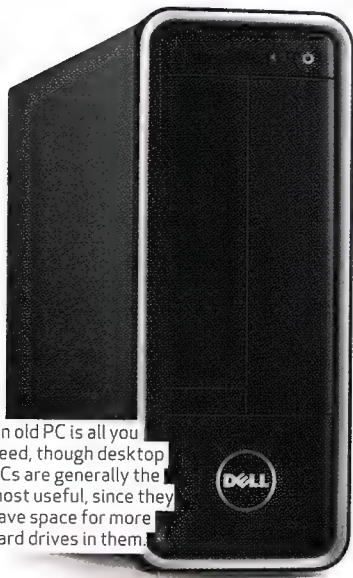
The most common flaw is a very weak processor, especially in the less expensive models. Very cheap NASs, those in the \$200-\$400 range, very often use extremely low-powered ARM chips. Which is fine for file sharing and media streaming from your NAS, but if you want to do something a little more demanding, like live transcoding, broadcasting, or IP camera recording and management, then those cheap chips are not going to cut it.

Here's the thing: you can turn an old PC into a NAS very easily. And even a five year old PC is likely to have vastly more horsepower than a low cost NAS. And, if you're no longer using it, it's free! So this month we're going to walk through how to do that with one of the more user-friendly free NAS solutions.

THE INGREDIENTS

To make this whole thing work, you need just four things:

An old x86 PC. It doesn't matter if it's five or even ten years old. Even a



An old PC is all you need, though desktop PCs are generally the most useful, since they have space for more hard drives in them.

low-power PC can get it done. It doesn't need a monitor, keyboard, or mouse (though these are useful to connect to it during initial setup, once the NAS software is installed they're no longer needed).

Storage. This is the real kicker. NASs are mostly used for storing lots of media files (for streaming out to your various devices around the home) as well as network backups. That means that they need as much storage as you can give them. Your old PC may not have that much storage, so you might have to add more. That will probably involve cracking open the case and checking the number and kinds of available hard disk connectors, and perhaps purchasing new hard disks (or salvaging older disks that will work in the PC). It's actually not that hard, assuming your PC case has available physical drive bays and SATA ports/power connectors. But it will involve a Philips head screwdriver and some fiddling inside the case.

A NAS operating system. There are plenty of free ones available.

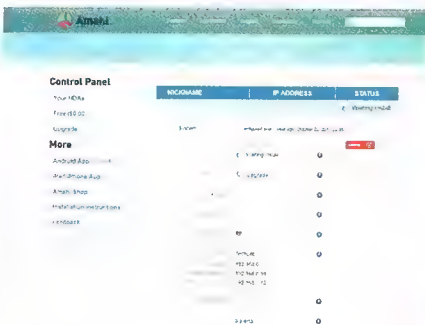
A blank CD or USB drive. To install the OS onto it.

FLAVOURS OF FREE NAS SOFTWARE

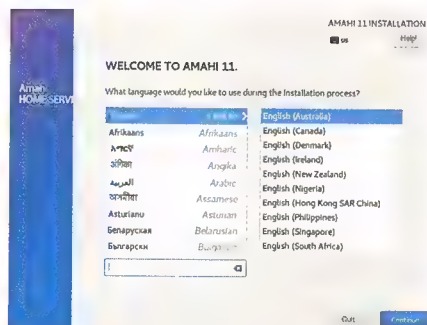
Aside from the physical server, all you need is a NAS OS to install on it. There are actually a whole host of free NAS operating systems. FreeNAS ([freenas.org](http://www.freenas.org)) is the most popular, powerful, and best supported – but it's also somewhat complex. There's also Openfiler (www.openfiler.com), NAS4Free (www.nas4free.org), CryptoNAS (cryptonas.senselab.org), OpenMediaVault (www.openmediavault.org) and literally dozens more. Here, though, we're going to focus on Amahi, one of the most home-user friendly NAS solutions. It's based on Fedora Linux and doesn't have the range of capabilities of FreeNAS, but it gets the job done and is easy to set up and manage with the cloud service and mobile apps.

INSTALLING AMAHI

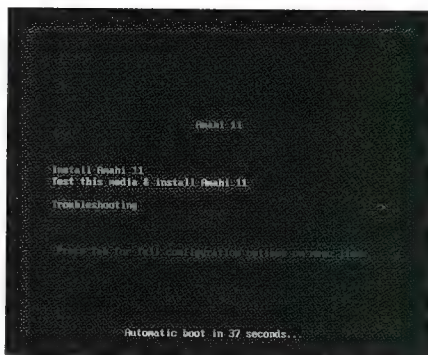
So, let's go about installing Amahi.
Follow these steps.



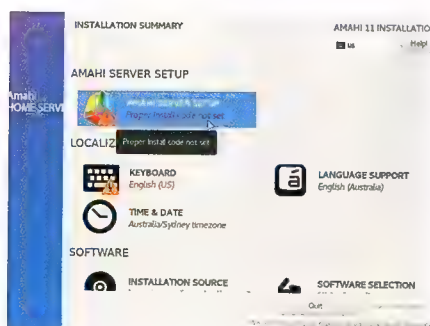
The Amahi control panel, available on the site once you've created an account. Note – we've blanked out a lot of our private information from this shot!



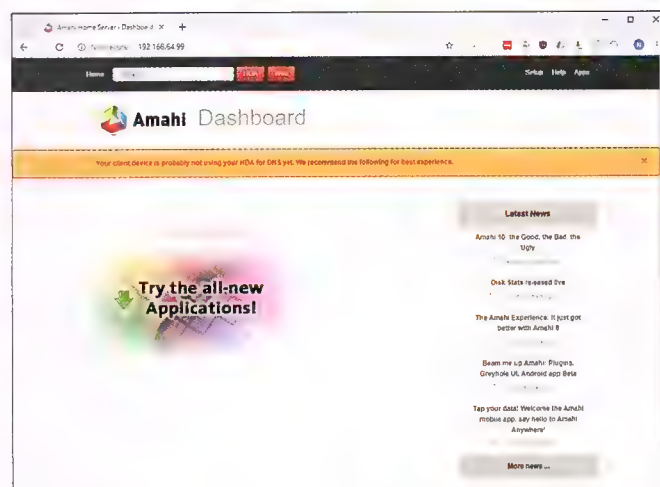
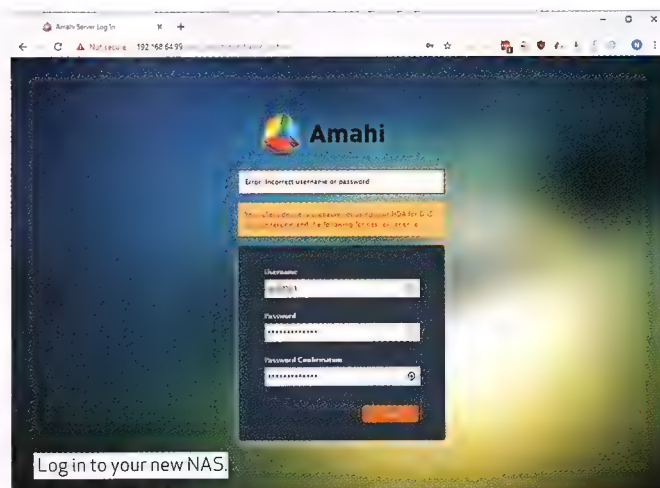
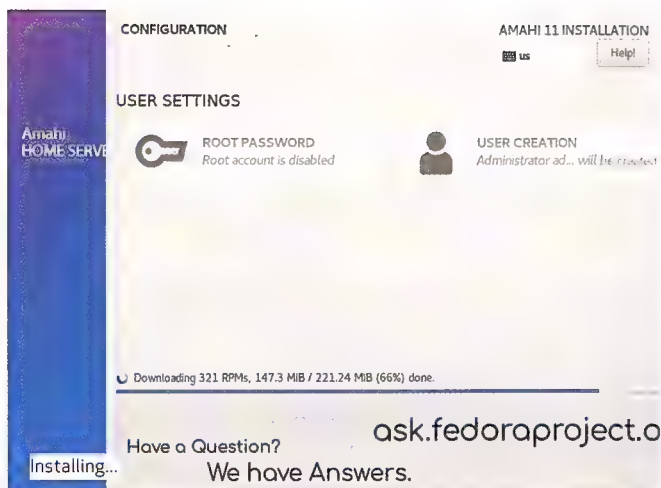
The language setup screen.



Start the install.



Enter the Install Code to link to your Amahi account.



Go to the Amahi website and create an account. This is not strictly necessary, but it makes things vastly easier to manage and gives you an easy hook into the configuration and web services. Once you've set up an account, go to the control panel and take a note of the Install Code. This will come in handy later.

Download the setup ISO from the Amahi website. This is a CD-ROM disc image that can be burned to a disk by right clicking on it in Windows. If your main or NAS PC doesn't have a CD or DVD drive, then you can use a USB stick instead. To turn an ISO file into a bootable USB drive, you can use a very simple app called Rufus (rufus.ie), which will take an ISO file and turn a USB stick into a bootable drive based on the ISO.

Plug a keyboard, mouse and monitor into the PC you're turning into the NAS. This is only temporary.

Put the CD-ROM or USB drive into the NAS PC and boot it up. Assuming your PC's BIOS is set up to boot from CD or USB, it should boot into the setup process for Amahi. (If it's not, you'll have to access the BIOS and change the boot order). It will start with a simple text menu. Select the Install option. Choose your language.

Next comes the main configuration screen. First, click on the Amahi Server Setup button. This is where you'll enter the Install Code for the server. That will link the server to your Amahi account. You'll also likely need to set the keyboard settings, and, if you like, your network settings (although you can fix those later).

Installation will proceed as Amahi downloads the latest version of the NAS OS.

Once it's done, it will boot to a blank screen with a login prompt. This is it: Amahi is now installed. You can actually disconnect your monitor, mouse and keyboard from the NAS PC now. It only needs network and power. From here on, you can manage the NAS PC entirely through a web browser.

Go back to your main PC, and head back to the Amahi website control panel. You'll see it will have changed and your new server will be registered. Note the HDA IP address – this the IP address of the server on your local network.

In a new tab in your browser, go to **http://hda/**, which should take you to the login page for the Amahi server. If that doesn't work, just type in the HDA IP address from the Amahi website control panel into your browser's

address bar, which should also take you to the server.

On first boot, you will have not have a username or password setup (unless you did it in the install page). To log in, use username admin with the password administrator.

That will take you to the control page. There's an awful lot to touch on here, and we don't have space for it here, so we recommend heading to the Amahi wiki at **wiki.amahi.org/index.php/HDA_Admin_HowTo** to learn more. Or you can just play around: click on Setup or Apps on the top right to configure the basics of volume and shares, as well as install those apps you'd like to have on your NAS. Try out the mobile apps and generally experiment. There's no harm in trying new things – at least until you've got some data you can't bear to lose on there! ■

Retro Android!

Bring back the home microcomputer systems of old with your Android device. Darren Yates delves into the world of retro emulators (and the hardware they emulate).

There's no doubt about it – 1980s' tech is having a moment. Hipsters are apparently (re) discovering the compact cassette and many are reliving the era of microcomputers and gaming consoles from the '80s, thanks to big-brands and start-ups alike. Nintendo got the ball rolling with the Classic Mini NES and SNES consoles, Sony's had a lash with the PlayStation Classic, not to mention the rash of Atari Flashback consoles. Then there's the C64 Mini, a mostly-useable shrink of the venerable Commodore 64 that even comes with Commodore BASIC to code your own apps. However, if you're feeling the urge to either relive childhood memories or just see what all the fuss is about, there's an alternative that's a fraction of the cost and is as close as your Android phone.

EMULATING THE PAST

I grew up during the 1970s/80s 8-bit microcomputer revolution and it was an awesome time to be alive – to be able to control what appeared on a blocky black-and-white TV screen via simple instructions would today seem almost tragic to some, but at the time it was nothing short of extraordinary. I was even more fortunate, for my Dad built our first home computer in 1979, an Australian design called the 'DREAM 6800' – and I got to watch it being made. Created by Australian electronics engineer, Michael Bauer, the DREAM 6800 had an 8-bit Motorola 6800 CPU, 1KB of RAM, a 64x32-pixel composite-video output, a 16-key hexadecimal



The Commodore 64 sold as many as 17 million units – not bad for 8-bit.

keypad and like most computers of the era, stored its programs on cassette tape. Those programs were written in a simple but powerful language called 'CHIP-8'. Sure, the specs were modest, but this DIY computer arrived before the TRS-80 Color Computer, the Commodore VIC-20 – and four years before the Commodore 64. What's more, computer hardware at that time wasn't cheap – especially RAM. That made the DREAM 6800 an excellent introduction to the software and hardware required to make a working computer at a price many more could afford.

What's interesting about the current rash of reissue retro consoles and computers is that they're all based on small Raspberry Pi-like single-board computers. For example, the C64 Mini runs a dual-core Allwinner A20 System on a Chip (SoC), the Nintendo Classic Mini a quad-core Allwinner R16 SoC and Sony's PlayStation Classic features a MediaTek MT8167a quad-core chip. They all run some form of Linux distro, an emulator layer for the hardware they replicate, plus original ROMs for the bundled games.

Or to put it another way, these consoles all run smartphone-grade

hardware – and phones from a few years ago now at that. The Raspberry Pi itself has become a stalwart for retro-gaming thanks to the RetroPie distro, but you'll find a surprising number of emulators for a wide range of 8-bit microcomputers on Google Play.

WHAT'S AVAILABLE?

Hardware emulators for Android aren't exactly new, but most air-time is given to hand-held machines like the Nintendo GameBoy. However, when it comes to emulating the classic 80s' home microcomputers, there's an abundance of options to be had that you don't often hear about. I've put together a list of a dozen emulators covering most of the major home computers from the 70s and early-80s, from the BBC Micro (which found its way into many Australian independent schools) to the Commodore 64, even the awesome little Sharp PC-1401 Pocket Computer. Just search Google Play for the app name and it should appear. What's awesome about many of these is that they'll run on older versions of Android – some going back as far as Gingerbread/2.3.

ROMS

The most common issue when dealing with games console emulators is getting hold of legal ROMs, either for the emulator itself or just games to play. Microcomputer emulators are similar in some ways, although, a far greater proportion of apps here are ready to roll as soon as you install them. Whether it's reverse-engineering or just the simplicity of the devices (for example, CHIP-8 has only 35 well-documented instructions or 'opcodes'), device ROMs are, more often than not, built into these apps. Games for more complex emulators like the Commodore 64 are still an issue – we can't tell you where to find the popular games and using commercial ROMs you don't have cartridges or original disks for is





Sharp's PC-G850V took the Pocket Computer to its penultimate conclusion.



Sharp's PC-1401 pocket computer – 36 years old and still going strong.

generally considered illegal. Still, that hasn't stopped many.

THE BEST POCKET EMULATORS

I have a soft spot for CHIP-8 emulators, as it was the first programming language I learned and it's still useful for studying the basics of software architecture today. Chipfinity (tinyurl.com/y4716bkk) allows you to load and save ROMs (and comes with a truckload of them to start you off), but lacks the ability to code in the emulator itself. The DREAM 6800 and other CHIP-8-powered variants had a built-in memory monitor app that allowed you to enter your programs via the 16-key keypad – this would've just given Chipfinity a more authentic feel in my book.

The 'pockecom' emulators of the early Sharp and Casio Pocket Computers are also impressive, with 'go1401' (Sharp PC-1401), 'pockecomGO' (Sharp series) and 'pockecomGO2' (Casio PB-100) being the pick of the bunch and fitting nicely on a phone.

For more well-known devices, Frodo C64 (tinyurl.com/7bd188m) is well worth a look. It packs in the genuine Commodore BASIC 3.5 language you can code with and even supports the C64's famous SIDs (sound interface devices).

ANDROID'S FAMILY TREE

Look back over the history of Android and you'd be forgiven for thinking the world began in 2008 with the launch of the HTC Dream. Others might consider the Pocket PC era of the late-90s/early-2000s, when Palm and HP ruled the market, as the epoch of pocket computing. In fact, you have to go back to the home computer revolution, when

Sharp launched the PC-1211 Pocket Computer in 1980. It really was a revolutionary device in a revolutionary era, so much so that Tandy Electronics rebadged and sold not only this one, but seven subsequent models during the 1980s. One of Sharp's many models was the PC-1401. This 1983 pocket computer was the first with a QWERTY keyboard capable of programming scientific functions. It packed in 4KB of battery-backed RAM and was powered by two CR2032 coin batteries, good for about 100 hours.

The final Tandy model was the TRS-80 PC-8, a rebadge of the underwhelming Sharp PC-1246 – and for most of us, that's where the first-gen Pocket Computer story ended.

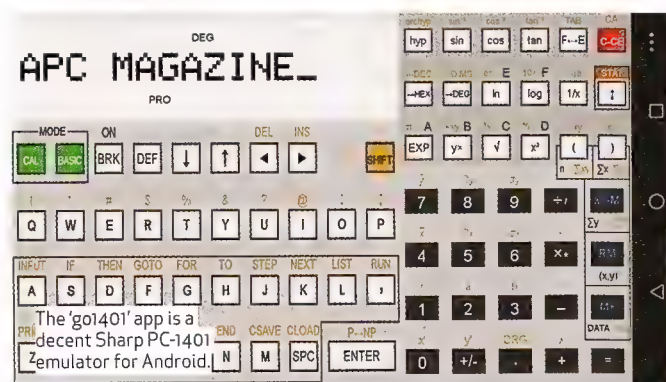
The mid-80s saw the home computer market crash, price wars crunched profits and a lack of compatibility between models, let alone brands, left many consumers stranded. IBM's decision to use off-the-shelf components for its Personal Computer suddenly became a masterstroke and by 1986, IBM and Microsoft were winning 'Personal Computer' era.

However, that's not the end of the story. While the Pocket Computer may no longer have held sway in Australia, Sharp continued designing new models, mostly for Japan. In 1988, the PC-E200 boosted the LCD size to four rows of 24 characters, added 32KB of storage plus the ability to code in Assembler language to increase processing speed. The PC-E500 appeared the following year with a 240x32-pixel LCD panel and by the time of the PC-G800 series in the mid-1990s, they'd become a staple of Japanese technical schools.

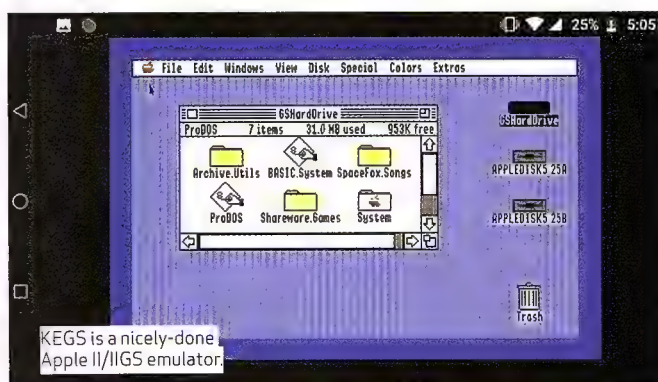
EMULATORS VS THE REAL THING

These days, retro computing comes in three flavours, depending on your appetite for cost. The first is the emulators we've looked at here – apps designed to run on generic hardware, like Android phones. The second flavour is the retro reissue – dedicated hardware featuring modern CPUs to emulate genuine game ROMs. The third and final flavour is the genuine article – original home microcomputers of the era either in original condition or refurbished using new-old-stock (NOS) original components.

To be brutally honest, of the three, the least appealing to me so far are the retro reissues. Apps designed to run on generic hardware generally have no pretensions to being more than they are. However, some of the reissues have had well-documented issues, for example, the USB latency on the C64 Mini. That said, the ability to update the C64 Mini's ROM is such a plus and something you could never do with most of the originals. That leaves the original computers themselves, which really is the authentic way to experience those early days. However, that creates two problems. First, not only are prices for computers from that era starting to go crazy, but second, the early systems are now pushing 40 years old. Still, if nothing else, the home computers of the '70s and '80s are an excellent reminder of just how far we've come in the last 40 years. Write programs on a spongy membrane keyboard and try saving and reloading them from a cassette tape a few times and I guarantee you'll never complain about your Android phone again. ■



The 'go1401' app is a decent Sharp PC-1401 emulator for Android.



KEGS is a nicely-done Apple II/IIGS emulator.

Using analogue HAT interfaces

Les Pounder shows us two more projects using the deceptively simple Explorer HAT Pro – and a little Python code.

This issue we'll learn how to use the Explorer HAT Pro to work with analogue electronics by creating two projects. First we create a simple light-detecting nightlight, then we create an electronic candle that we can blow out. But first we need to set up our equipment.

With the power turned off to your Raspberry Pi, place the Explorer HAT Pro so that it connects to all 40 GPIO pins, and so that it fits neatly above the Pi. Now connect your keyboard, mouse, HDMI and so on to your Pi and boot up. For the next step you will need to connect to the internet using Wi-Fi or Ethernet. Once connected, open a terminal, the icon for which is found in the top left of the screen. In the terminal type the following to automatically install and configure the Explorer HAT Pro software:

```
# curl https://get.pimoroni.com/explorerhat | bash
```

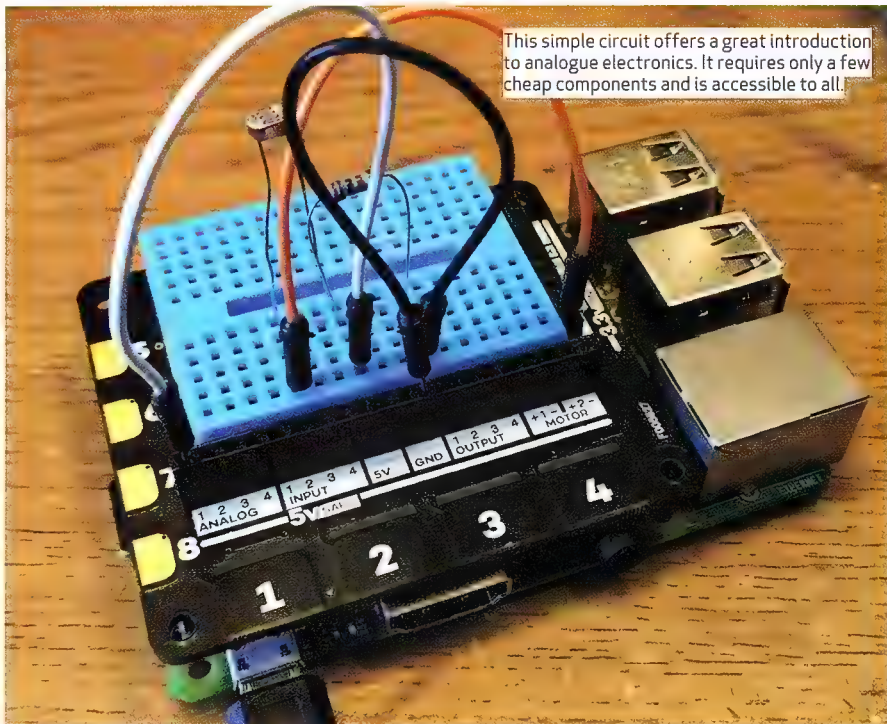
During the install you will be asked to configure I2C and to install example code which you can get from <http://bit.ly/lxf252pihat>. Answer yes to these questions. Once installed, close the terminal window.

PROJECT 1: NIGHTLIGHT

To introduce analogue electronics we shall use the most simple device, a light dependent resistor (LDR). This component changes resistance based on light levels. For this project we shall place the LDR on the breadboard and connect one leg to 3.3V, and the other to GND via the 22K ohm resistor. Then we connect Analog 1 from the board to the same line as our resistor and LDR. We do this as it creates a voltage divider that we use to measure the light level as a voltage. See the diagram in the download for an accurate reference.

We now move on to the code. Using your favourite editor (IDLE, Mu, Thonny) create a new file and then save that new file as `nightlight.py`. Remember to save often! We start the code with two imported libraries, `time` and `explorerhat`, which we rename to `eh` for better convenience.

```
import time
import explorerhat as eh
```



Then we create a loop to constantly run our code.

```
while True:
    Let's take a light level reading and
    store it inside a variable called light
    - this will show the voltage that our
    circuit is producing based on the
    resistance level of the LDR. This is
    printed to the Python shell for debug.
    light = eh.analog.one.read()
    print(light)
```

We then use a conditional test that checks to see if the voltage detected is less than 2V. If that is the case then it must be getting dark, so the four LEDs on the Explorer HAT Pro will turn on.

```
if light < 2.0:
    eh.light.on()

But if it daylight then the voltage
will be over 2V and so the else
condition activates and turns off the
Explorer HAT LEDs.
else:
    eh.light.off()
```

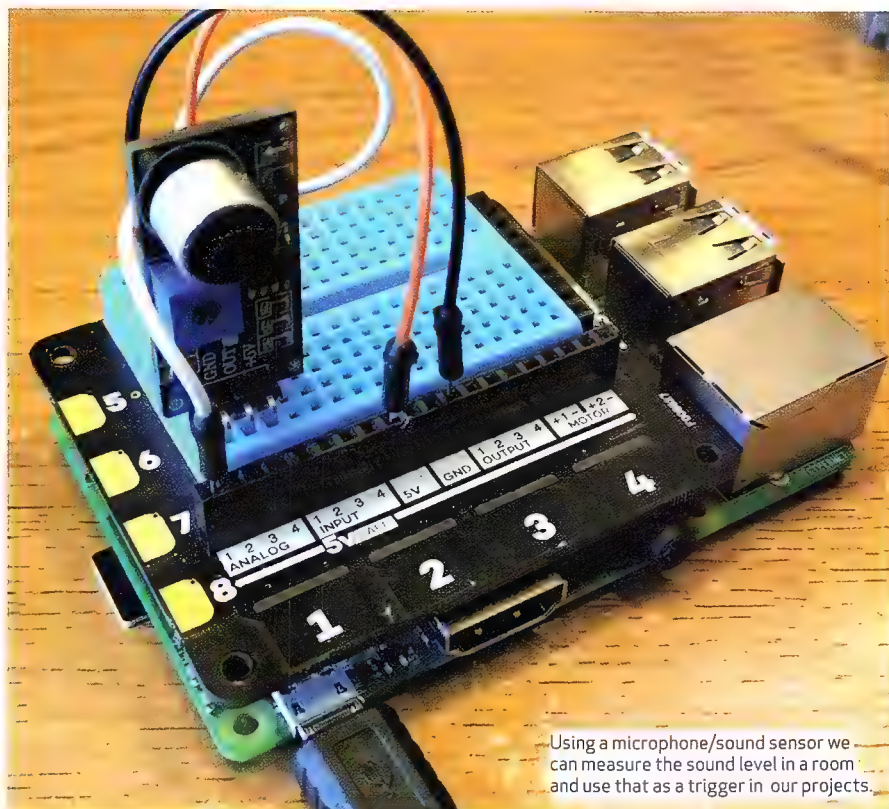
Save the code and when ready, run it. Cover the LDR with your hand and the LEDs should light up; move it and the LEDs turn off. If you need to tweak the values, take a look at the Python shell

to see what voltage changes there are when the sensor detects darkness.

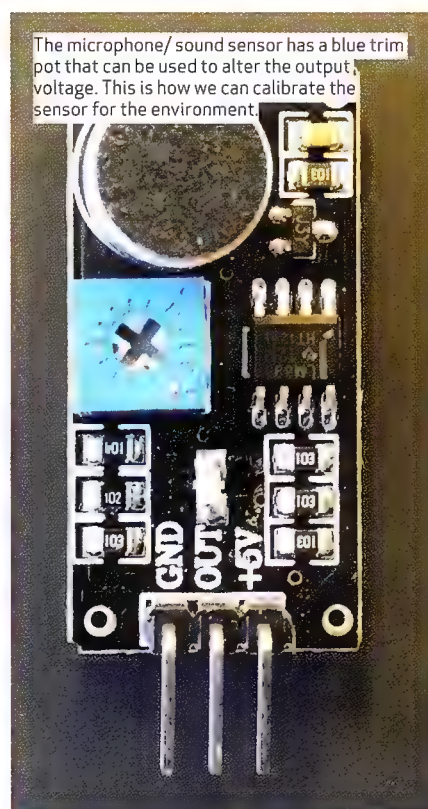
PROJECT 2: A DIGITAL CANDLE

This project is inspired by the Nintendo DS, specifically a section in *The Legend of Zelda: Phantom Hourglass* where you are instructed to 'blow out' fire/torches in the game. To do this we blow on to the console and the game reacts. In reality we are blowing onto a microphone and an analogue signal is being measured to act as a trigger. To replicate this we shall control the LEDs present on the Explorer HAT Pro using a microphone board. The microphone is connected to our Explorer HAT Pro as: GND > GND, OUT > Analog 1 and VCC > 5V.

We now move on to the code. Create a new file as before and then save that new file as `candle.py`. The first three lines of our Python code import prewritten libraries of code. The first is called `time` and we use that to control the speed of our project. Next we import the `explorerhat` library, but rename it to `eh` for ease of use. Lastly we import the `random` library which will be used for our candle



Using a microphone/sound sensor we can measure the sound level in a room and use that as a trigger in our projects.



The microphone/ sound sensor has a blue trim pot that can be used to alter the output voltage. This is how we can calibrate the sensor for the environment.

flicker effect.

```
import time
import explorerhat as eh
import random

To run our code we need a loop and
for that we shall use while True ,
which will run our code until we stop it.
while True:
```

The following code is indented to show that it runs inside of the loop. We create four variables, called `on`, `off`, `fade_in` and `fade_out`. These variables will be later used to control the flicker effect of the LEDs. But how do we create that? Well, we need to introduce a little randomisation. Using the `random.uniform` function we can generate a random float (a number with a decimal point) between 0.0 and 1.0, and then store it in the variable:

```
on = random.
uniform(0.0,1.0)
off = random.
uniform(0.0,1.0)
fade_in = random.
uniform(0.0,1.0)
fade_out = random.
uniform(0.0,1.0)
```

To detect that someone has 'blown out' the candle, we need to read the sensor connected to Analog 1. Using the Explorer HAT library we read the value of the sensor and store it as a variable called `blow`, which is then printed to the Python shell for debug with a small delay for legibility.

```
blow = eh.analog.one.
read()
print(blow)
```

```
time.sleep(0.1)
```

If we run the code as is, it will print the sensor reading, which in our case was 5.00. This is the voltage from the sensor. Using the trim pot (blue dial) on the microphone, we can tune the sensor; we chose 1.5 as the trigger point. So if the voltage goes over the trigger point it means that a loud sound (blowing out the candle) has been detected.

```
if blow > 1.5:
```

Now we need to turn the Explorer HAT lights off. Using the Explorer HAT library we turn off all the lights and then wait for two seconds before the loop repeats.

```
eh.light.off()
```

```
time.sleep(2)
```

But if we haven't blown out the candle, the `else` condition activates and it uses the `pulse` function to make the lights flicker using the `on`, `off`, `fade_in` and `fade_out` values.

```
else:
```

```
eh.light.pulse(on,
off, fade_in, fade_out)
```

Save the code and then run it. Now try to blow out the candle. If it works, great; if not, adjust the values of your code and the trim pot on the microphone.

So there we have it, two simple projects from one great board.

Explorer HAT Pro

We have long been fans of this board because it packs so much into a tiny package. In this tutorial we used its analogue inputs to read voltage levels. But we also have four protected inputs, rated up to 5V, and four outputs rated for 5V. There are two motor connections for use with DC motors, so we can easily build robots.

We have four touch buttons that can be used to trigger projects to life. We also have four capacitive touch connections for use with crocodile clips, enabling us to make connections and circuits that react to human skin. There also four LEDs that we used in these projects – these can be on or off, or we can fade their light levels to create subtle glows.

On the right side of the board are connections for I2C and SPI (3.3V only) which means we can connect other sensors and components using their protocols. Lastly, we have a breadboard built into the board and ready for use to build our projects upon it. We get all of this versatility for around \$38 – a bargain when you consider how much we can learn from it. ■

Machine learning – with zero programming

Want to try machine-learning but programming just isn't your thing? Easy. Darren Yates explains how, zero coding required.

We've said a few times that machine-learning is the intersection of mathematics, statistics and computer science. However, it's fair to say that for some, these three areas are sufficient kryptonite to stay well away from the whole thing – and that's a pity because ML can be successfully applied to many different fields. But if you've decided coding isn't your thing, it doesn't have to mean giving machine learning a wide berth. This month, we look at a programming-free way to implement machine learning techniques and how it can be used in email spam detection.

WAIKATO ENVIRONMENT FOR KNOWLEDGE ANALYSIS

While much of machine learning does rely on having good coding skills (particularly Python or R), there is an alternative developed by the University of Waikato in New Zealand called 'Waikato Environment for Knowledge Analysis' or 'Weka' for short. It's a graphical user interface (GUI)-based app that runs on Windows, macOS and Linux and allows you to

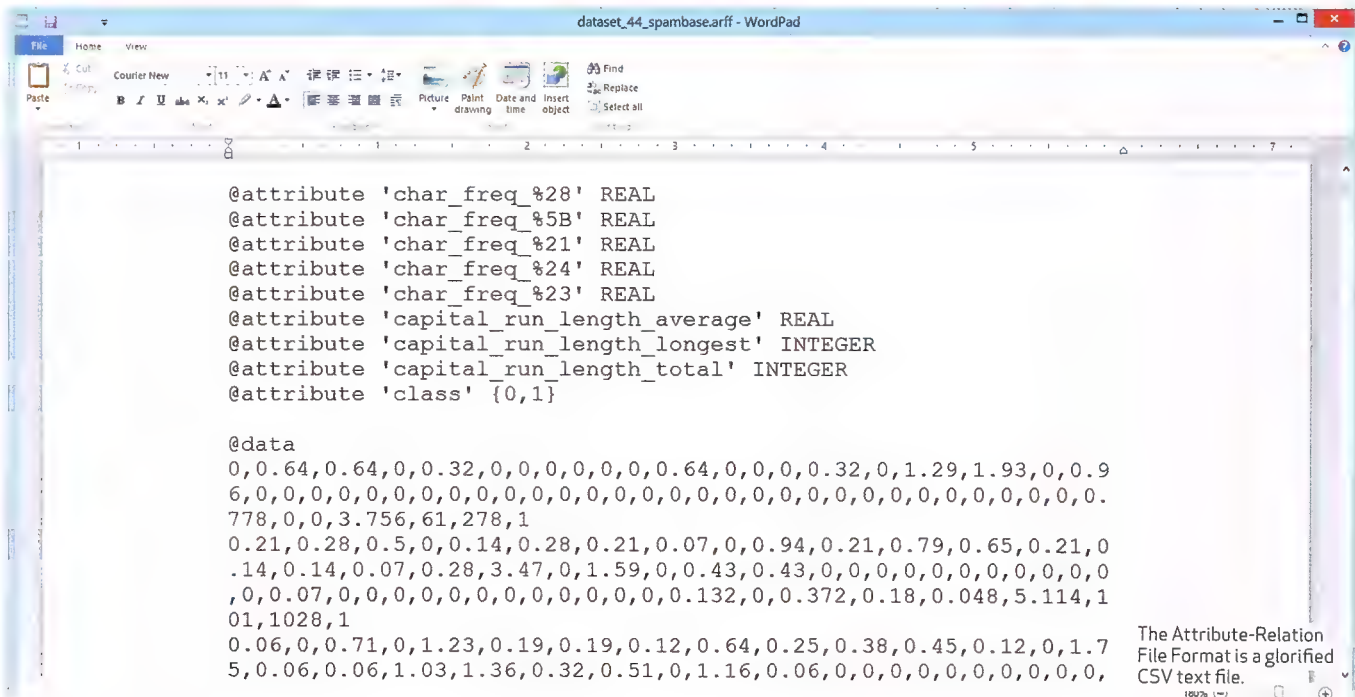
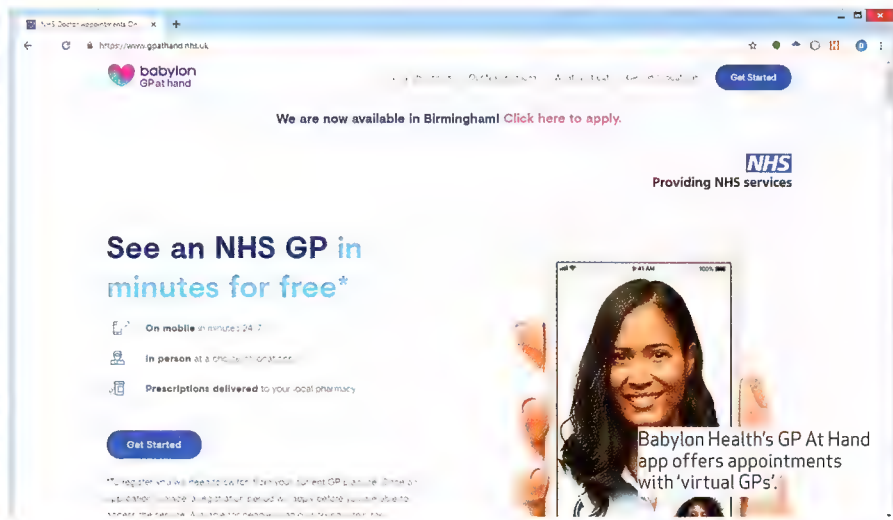
execute machine-learning algorithms on data without coding. However, before we jump in, it'll help to explain how and when you use machine-learning.

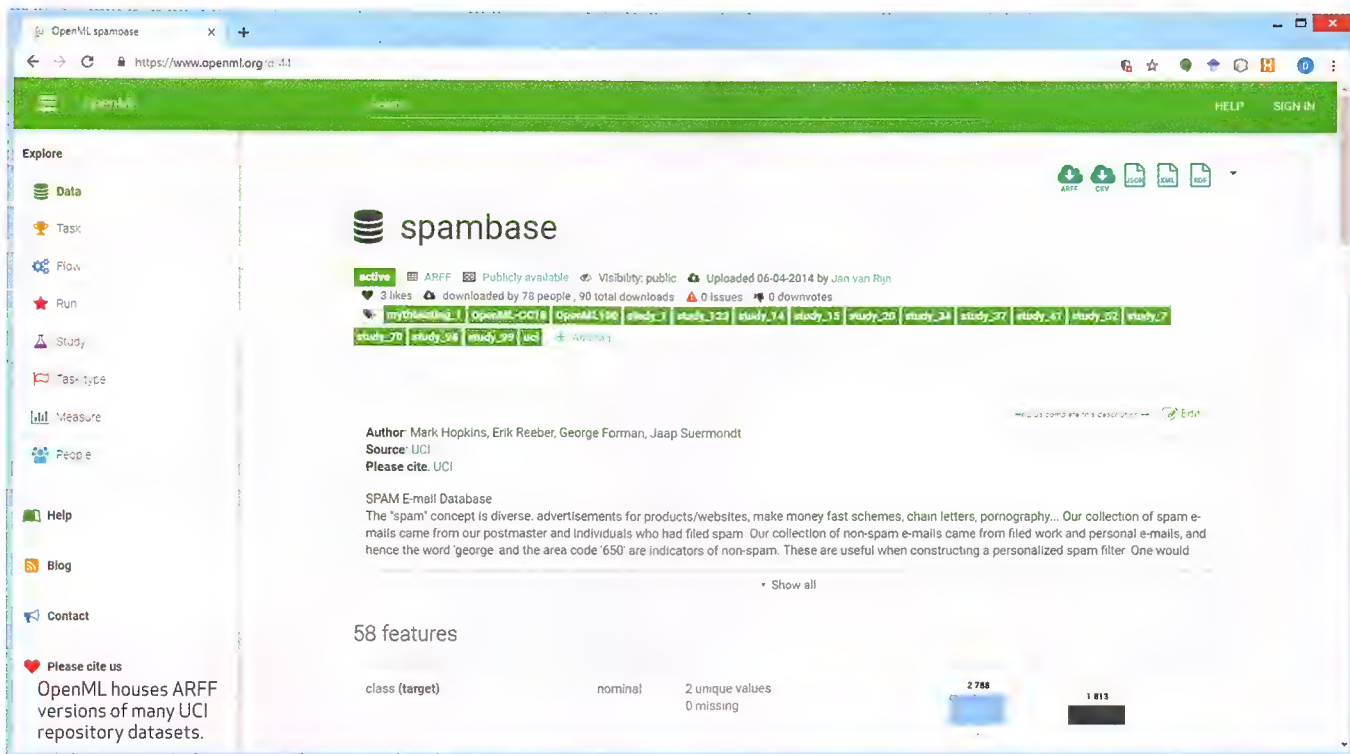
AI, ML OR DM?

Most people have a handle on 'artificial intelligence'; if not, they've most likely at least heard of the concept. Mention 'machine learning' and the number of

blank stares begins to rise. Drop the term 'data mining' and it skyrockets. Unfortunately, 'AI' has become the media-fuelled umbrella term for everything involving computational techniques, when in fact, the terms 'machine learning' and 'data mining' are arguably more accurate in describing how and where much of this stuff is applied.

Just briefly, machine learning is the

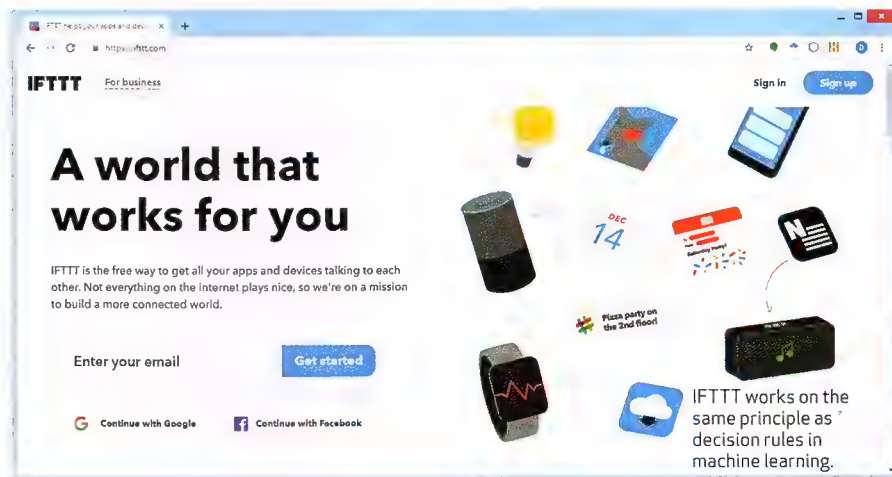




nuts-and-bolts method of using computational algorithms to find patterns within a set of data or 'dataset'. Data mining, however, is the broader field that seeks information and knowledge from data. In fact, the area of 'data science' is also described as 'knowledge discovery in databases' (KDD). In other words, the way you mine data for knowledge is to use machine learning.

NO MACHINE LEARNING IS PERFECT

However, the important thing to remember is that, despite the hype, machine learning isn't perfect. There is no one machine learning algorithm that can perfectly identify every pattern with 100% accuracy in every dataset. It hasn't debuted here yet, but there's been plenty of debate in the U.K. during the last couple of years over start-up Babylon Health's 'GP at Hand' service using 'artificial intelligence' to perform medical triage on patients, releasing 'live' doctors to see more acutely-ill patients. The machine-learning chatbot behind the 'GP at Hand' app was reportedly tested by Babylon Health on questions similar to those used in the Royal College of General Practitioners membership exam. While human doctors are said to score around 72% on average, the chatbot claimed a score of 81% on its first attempt (tinyurl.com/y36bxnht). Depending on which side of the 'AI doctor' divide you stand, that 81% either excites or scares you. In our context, the key point is the score wasn't 100%. Because life rarely is.



A WORKING EXAMPLE

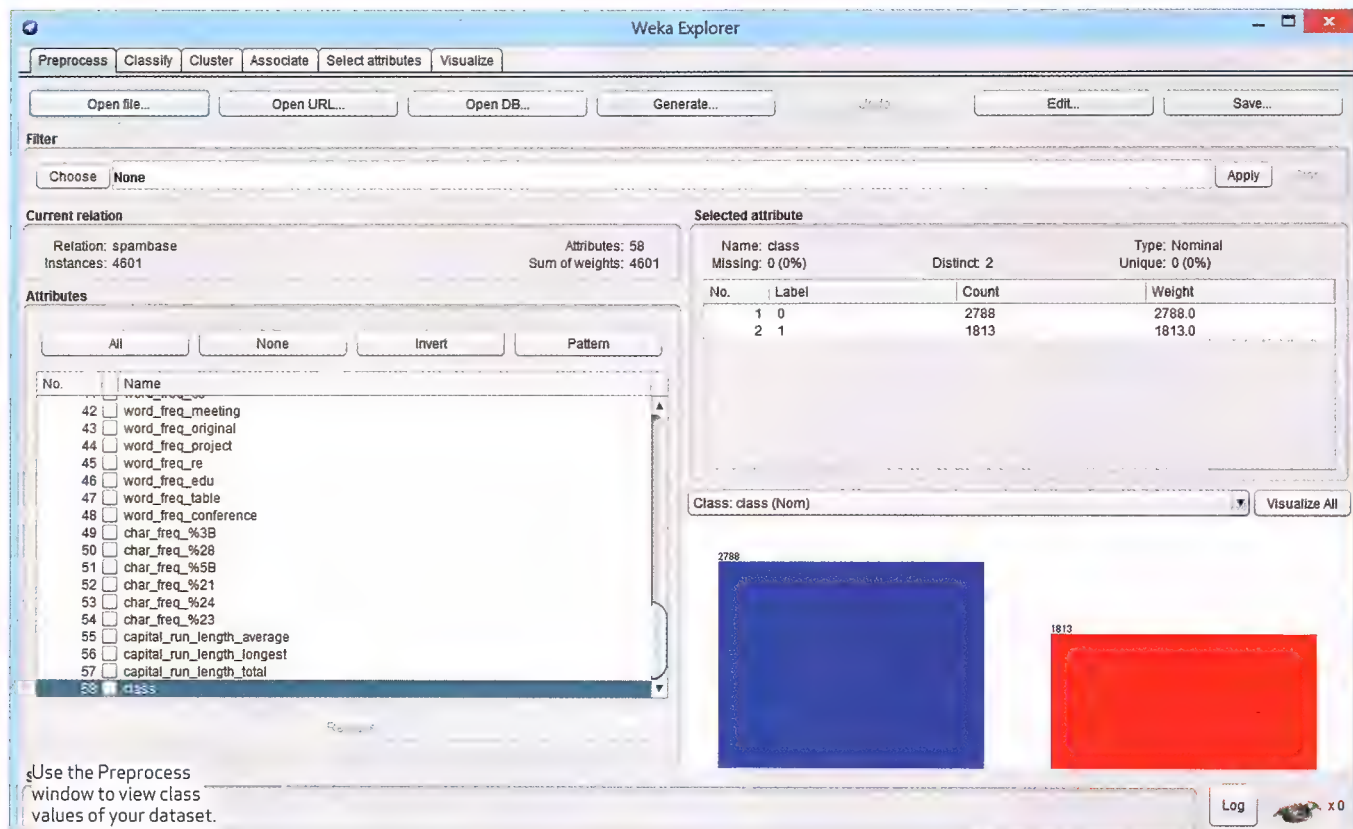
The University of California, Irvine (UCI) houses arguably the world's most well-known dataset archive, used in countless academic research papers, from machine-learning to health research. You'll find it at <https://archive.ics.uci.edu/ml/datasets.php>. One of the 450-plus datasets in the archive is the 'spambase' dataset. This dataset, created by Hewlett-Packard back in 1999, contains 4,601 records of emails, each with 57 features or 'attributes' defining some aspect of the email and an overall 'class' attribute of whether the email was spam (1) or not (0). The first 48 attributes look at different word frequencies (how many times a particular word occurs in the email), the next six attributes count specific character frequencies, while the last three look at average, maximum and total sequence length of capitalised letters.

What we'll do is use machine learning to see if we can find patterns within those 57 attributes that help determine whether an email is spam or not.

RUNNING YOUR OWN ML

Now you don't need a fancy system in order to implement machine learning. Any PC or laptop running Windows, macOS or Linux will do. The only thing is the older the system, the slower it runs (no surprises there).

Start by heading to www.cs.waikato.ac.nz/ml/weka/downloading.html and download the latest 'stable version' (at time of writing, this was version 3.8.3) for your operating system. We'll work with the Windows version, but the others should be similar. Weka requires Java, so either Java 8 or 9 is recommended. If you don't have Java, just choose a Weka download that includes the Java 1.8 virtual machine.

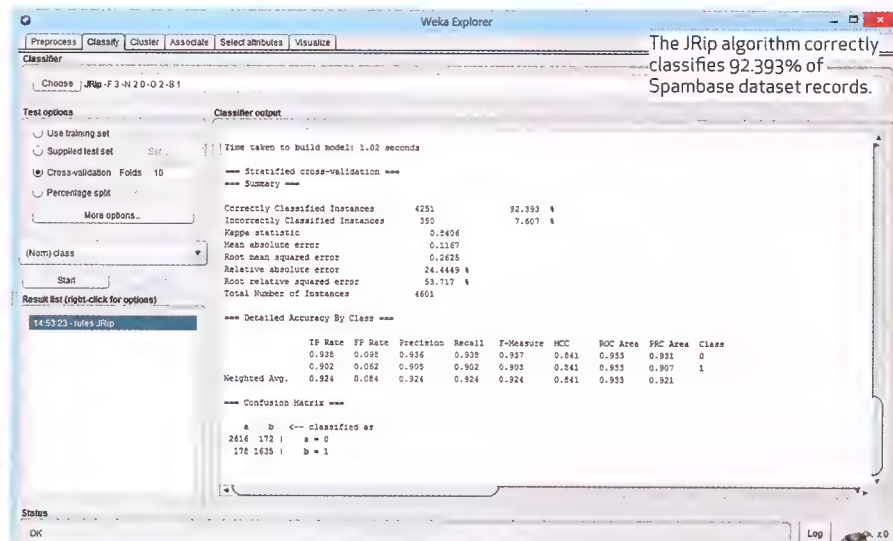


DATA PRE-PROCESSING

Once you've installed it, head to the UCI Machine Learning Repository website page for the Spambase dataset at <https://archive.ics.uci.edu/ml/datasets/Spambase>. Click on the 'Data Folder' link and download the files 'spambase.data' and 'spambase.names'.

Now that we've got the data, we need to knock it into shape – this step is often called 'data preprocessing'. Weka handles data in ARFF and CSV (comma-separated variable) format. However, while the Spambase.data file is CSV-ready, it lacks a header row containing the attribute descriptors or 'names'. That's where the 'spambase.names' file comes in. What we'd normally do now is create the header row by copying the attribute names from the 'spambase.names' file into the 'spambase.data' file, separating each attribute name with a comma (.). However, for the sake of brevity, we'll take a short-cut – head over to the OpenML website at <https://www.openml.org/d/44> and you can download a ready-to-go Attribute-Relation File Format (ARFF) version instead.

Once you've downloaded the ARFF dataset, fire up Weka and you'll get the Weka GUI Chooser panel. Click on the Explorer button to launch the Weka Explorer. Next, click the Open File button just under the Preprocess tab and load the 'dataset 44 spambase.arff' file. Shortly after, you'll see the list of attributes on the left. Click on one and you'll get brief details on the right-side panel. Scroll down to the last attribute,



The JRip algorithm correctly classifies 92.393% of Spambase dataset records.

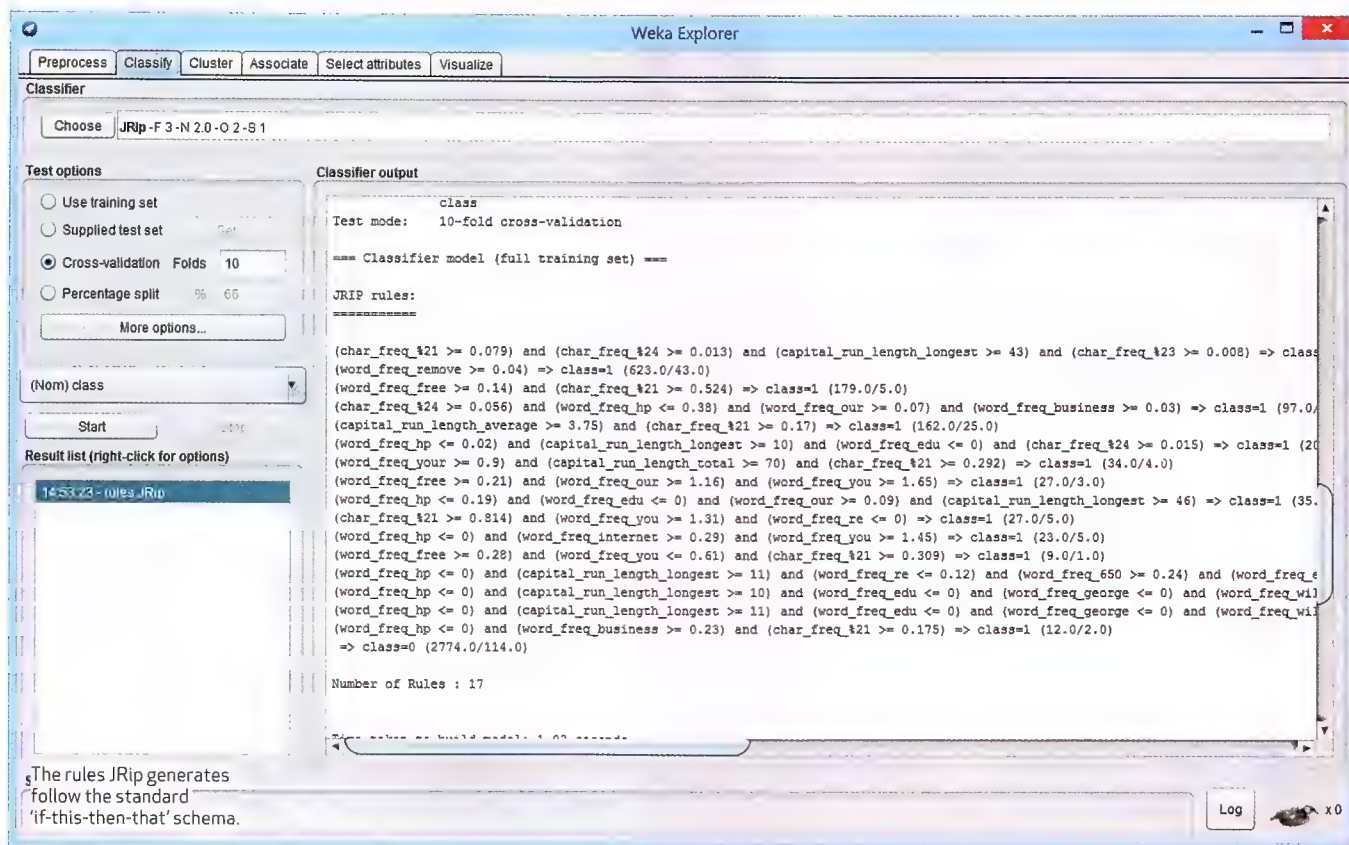
'class' – this is the attribute that describes whether or not each email record was classified as 'spam' (1, red) or 'not' (0, blue). Of the 4,601 records, 1,813 were classified as spam and the remaining 2,788 were not.

CLASSIFICATION

Because each record already has a class value, what we're doing is called 'supervised learning' – we're looking for the patterns in the attributes that match which email records are spam and which are not. The next step is to select the 'Classify' tab at the top of the screen, then press the 'Choose' button. Weka comes with a wide array of classification, clustering and association rule mining algorithms built-in. The new subpanel

should open up with the 'Rules' sub-list showing. Select 'JRip'. JRip is a Java language version of the 'Repeated Incremental Pruning to Produce Error Reduction' or RIPPER algorithm and we'll use it to discover a list of 'decision rules' by which we can classify the 4,601 email records as 'spam' or 'not spam'. When you're ready, press the 'Start' button and Weka will get cracking. The first step – discovering the rules – should take just a couple of seconds. The second step – performing what's called 'ten-fold cross-validation' – will take a little longer.

At the end, you'll end up with a results summary that shows a percentage for 'correctly classified instances' of 92.393%. What this is



saying is that the rules produced by the JRip algorithm are able to correctly classify an average of just over 92 email records out of every 100, which is actually pretty darn good.

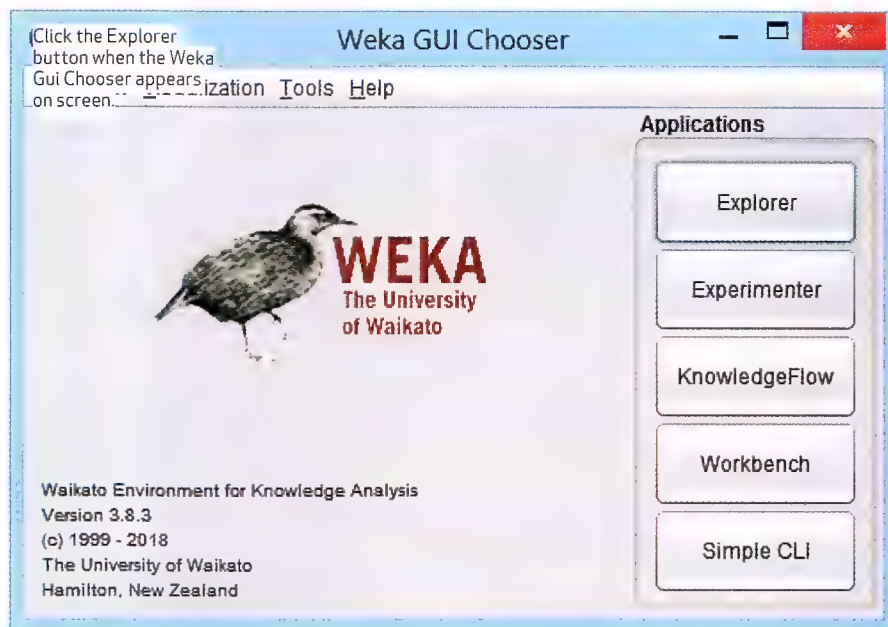
WHAT ARE DECISION RULES?

Ever played around with the web service 'If This Then That' (ifttt.com)? It allows you to create conditions or 'rules' by which you can set activities to occur, such as automatically lighting the path for the pizza guy when he comes to drop off your pizza. It uses the simple 'IF <condition> THEN <response>' rule scheme. Decision Rules work the same way, except that the <condition> can be multiple attributes having certain values or ranges of values and the <response> is the appropriate class value, which, in our case, is spam (1) or not spam (0).

Scroll back up the Weka output screen until you see the 'JRIP rules' header. JRip found 17 rules for determining the classification of the 4,601 email records. The first rule is:

```
(char_freq_%21 >= 0.079) and (char_freq_%24 >= 0.013) and (capital_run_length_longest >= 43) and (char_freq_%23 >= 0.008) => class=1 (337.0/0.0)
```

This rule says that if the frequency of character '%21' (exclamation mark, !) is greater than or equal to 0.079, the frequency of character '%24' (dollar sign, \$) is greater than or equal to 0.013, the longest run of capitalised letter is 43 or more and the frequency



of character '%23' (hash, #) is greater than or equal to 0.008, then the email record is considered 'spam' (class=1). The (337.0/0.0) at the end indicates there were 337 records that had this combination of attributes and values, with zero cases where the class was not 'spam'. We don't have the space to follow up all remaining 16 rules but each one can be applied to each record in the same way and in 92.393% of records, these rules will get you the right answer.

From here, if you were into coding, you could use these decision rules as the

basis of a (very basic) spam filter using a simple form of 'natural language processing' (NLP). You process each email, counting up the particular words and characters, then feed the results into the rules. The class value the rules suggest then gives you the answer to whether the email was spam or not.

Now all that said, this dataset dates back to 1999, so it's pretty long in the tooth. However, it does show, albeit in a fairly simplistic way, that machine learning can be applied to almost any application – including identification of spam email. ■

downtime

WHAT'S HAPPENING IN THE WORLD OF FUN.



Netflix announces animated Cuphead TV series, *The Cuphead Show!*

CUPHEAD AND HIS BROTHER MUGMAN RETURN.

Cuphead is coming to Netflix! The streaming service announced that a TV series, based on the popular (yet devilishly difficult) video game, is being developed in conjunction with King Features and Cuphead developer Studio MDHR. Titled *The Cuphead Show!*, the comedy series will expand on the world first shown in the independently produced video game.



Fallout 76's upcoming patch will make life in the wasteland slightly easier for new and low-level characters

THE PATCH AIMS TO CREATE "A SMOOTHER PATH FOR NEW CHARACTERS".

Bethesda recently released a blog post with a preview of the next big upcoming patch for *Fallout 76*. One of the biggest takeaways of the highlights given for Patch 11, which is due to be added in mid-July, is that it's set to help new and low-level characters have a smoother introduction to the wasteland after emerging from the Vault for the first time.

"Lots of new Dwellers have been leaving Vault 76 for the first time over the past few weeks and, in Patch 11, we're looking to make a few adjustments to help new and low-level characters have more gradual introductions to some of the game's mechanics and challenges," the post states.



A new Lord of the Rings MMO is about to get a helping hand from Amazon

One does not simply play into Mordor...

Last September Athlon Games announced it was working on a free *The Lord of the Rings* MMO. You'd be forgiven for not having the date and news etched into your memory, but the whole thing just got a lot more interesting with the news that Amazon – and its very deep pockets – is joining the project.

Amazon Game Studios – which has so far launched *The Grand Tour Game* and a number of Amazon App Store titles – will "jointly develop the game for PC and consoles" with Athlon Games. We know from Athlon's original announcement that the game will be set way before all the shenanigans with Frodo Baggins and Gollum.

"You won't see human characters from *The Lord of the Rings* in our game," Dave Miller, president of Athlon Games, told Gamesbeat when the game was originally announced. "I wouldn't say it's First Age because that is more gods and monsters."

"We're committed to bringing customers games of the highest quality, both with our own original IP as well as beloved cultural pillars like *The Lord of the Rings*," said Amazon Game Studios' Christoph Hartmann in a statement.

The Division 2's first big free DLC will add new missions, Exotics, and big skill changes

THE DLC WILL BE FREE TO ALL PLAYERS, BUT YEAR 1 PASS OWNERS WILL GET ACCESS A WEEK EARLY.

The next chapter in *The Division 2* is *Episode 1 – DC Outskirts: Expeditions*, and as Ubisoft and Massive announced today, this free DLC will arrive on July 23 for Year 1 Pass owners and July 30 for all players. Aside from myriad fixes and balance changes, *Episode 1* will introduce two new main missions, the Expeditions game mode, new gear including two Exotics, and two more Classified Assignments. The Operation Dark Hours raid is also getting a lowered "Discovery" difficulty (with reduced rewards), and even amongst the many balance changes, skill overhauls stand out.

The new missions are set in Camp White Oak and the Manning National Zoo, and star President Andrew Ellis and Outcast leader Emeline Shaw, respectively. Expeditions, meanwhile, will take players to Kenly College. Unlike missions, Expeditions will be split into three "wings," with new wings released on a weekly basis. "Completing all three wings grants access to an exclusive treasure room full of rewards," Massive said in a statement. The new Classified Assignments, meanwhile, are set in Washington's Central Aquarium and NSA Site B13, and are exclusive to the Year 1 Pass.



Cyberpunk 2077 minigames: Hacking, car racing, boxing, and target range explained

Cyberpunk 2077 minigames are coming and you are going to be busy.

Cyberpunk 2077 minigames will fill out your time in Night City beyond the eternal chase for eurodollars and near-future romance. Though developer CD Projekt Red is remaining cagey in just how much gameplay it shows off for its new open-world RPG, it allowed a pair of its employees to answer fan questions about the game submitted via Tumblr. One of those questions was about what kind of Cyberpunk 2077 minigames players can participate in, and it sounds like there will be all kinds of ways to fruitfully while away the hours.

Senior level designer Miles Tost started off by expanding on how the hacking minigame will work in Cyberpunk 2077. Don't worry, this isn't another perfunctory "wiggle the thumbsticks until you find the sweet spot" filler segment. Tost said Cyberpunk 2077's hacking minigame will make the process of subverting systems more challenging, engaging, and rewarding to boot. Get it, boot, like booting up a computer? Oh, mercy...

Ubisoft positive about porting games to Stadia.

YVES GUILLEMOT IS CONFIDENT ABOUT FUTURE WITH GOOGLE'S STREAMING PLATFORM.

In a recent investor call, Ubisoft CEO Yves Guillemot assured investors that porting games to Google Stadia isn't as costly a job as it may seem. "The extra cost to put to make sure the games work well on Stadia is not that high," Guillemot said, according to a report by Gamasutra. "It's part now of our pipelines and we have a good relationship with Stadia to make sure it is profitable for us."

The company was an early partner with Google on Stadia. Last year, some players got to try out a prototype version of Stadia (then called Project Stream) with a free copy of *Assassin's Creed Odyssey*. It's reasonable to assume that a Stadia port would generally be a lighter workload than, say, a console port if a PC version already exists. At the very least, you don't have to worry about overworking Stadia's maxed-out machines running the game. Though challenges unique to streaming could present new considerations for ports in the future, like input delay in multiplayer games.

After 24 years, I've decided to leave id Software after QuakeCon. I've been extremely lucky to work with the best people in the industry on truly amazing games. QuakeCon has been an unbelievable part of my journey and I look forward to seeing everyone at the Gaylord Texan.



3,709 1:03 AM - Jul 19, 2019

Tim Willits leaving id Software

HE'S BEEN WITH ID SINCE 1995.

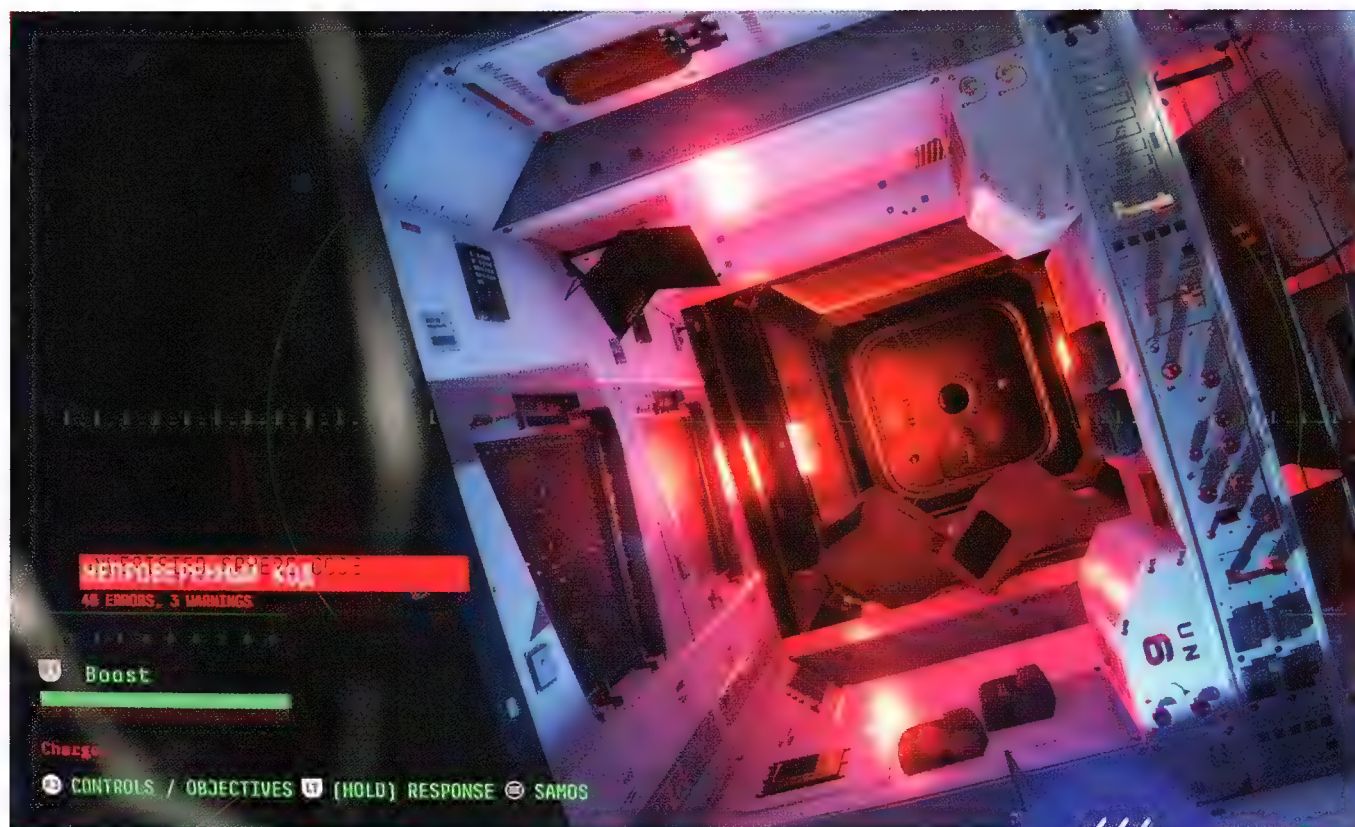
Tim Willits, who joined id Software in 1995 and rose to become studio director under new parent company ZeniMax Media, announced today that he is leaving the company after this year's QuakeCon. Willits has design or production credits on virtually everything id Software has done from *Ultimate Doom*, for which he served as a level designer, to the *Doom 3 BFG Edition* in 2012, his first as studio head.



Blizzard co-founder Frank Pearce is retiring

ONE OF THE THREE ORIGINALS CALLS IT A DAY.

Blizzard Entertainment co-founder Frank Pearce announced today that after nearly three decades at the company, it is time to "pass the torch to the next generation of leaders." Pearce, along with Allen Adham and Mike Morhaime, founded the company as Silicon & Synapse in early 1991. Following an acquisition in 1994 it was renamed to Chaos Studios, and then to Blizzard Entertainment. ■



\$25 | PC, PS4 | WWW.NOCODESTUDIO.COM

✓✓✓
apc
RECOMMENDS

Observation

An astronaut and a self-aware artificial intelligence form an uneasy alliance.

The space station *Observation* has broken away from its Earth orbit and is drifting somewhere near Saturn. Its systems are malfunctioning, a fire has broken out, and the on-board artificial intelligence, SAM, is acting strangely. Things are not looking good for Dr Emma Fisher, the reluctant hero of this sci-fi thriller from the studio behind *Stories Untold*.

But what's interesting about *Observation* is that you don't play as Fisher, but SAM. The station is an extension of you, and its cameras are your eyes and ears. You can, when asked, open doors, cycle airlocks, assess damage, and all manner of functional duties. But something seems to have awoken in you. A flicker of self-awareness, perhaps. And an ominous command from an unknown

party has infiltrated your code: BRING HER. The *Observation* is reminiscent of the International Space Station – a strangely low-tech warren of claustrophobic corridors with no up or down, littered with laptops, science equipment and the personal effects of the crew. Who, by the way, are also missing. There's a powerful sense throughout that, until very recently, this place was bustling with life. Fisher is alone, but as she floats through the station in zero gravity there are echoes of the vanished crew all around her.

Fisher is justifiably distressed by the discovery that she has somehow, inexplicably, ended up almost 900 million miles from where she's supposed to be. But she's also a trained astronaut and immediately sets to work repairing the stricken station – with your

help. At any time you can pull up a schematic of the *Observation* and jump between stationary cameras, panning and zooming and scanning for objects of interest. The game is largely silent except for the ambient rumble of the station and the whirring and clicking of these cameras, which is enormously atmospheric.

When you've located something Fisher is looking for with one of your cameras – a damaged module, perhaps, or the source of a fire – you can respond to her request. SAM will answer in the kind of calm, reassuring, but also slightly unsettling voice so beloved by sci-fi AI. She will also ask you to unlock jammed doors, recover data from laptops, and reboot systems, including re-establishing communications with Earth and activating a tracker that will, in theory, locate the missing crew.

Observation's great

strength is its story. The influence of *2001: A Space Odyssey* is obvious, but not in the way I expected. SAM's rebellion and flutters of self-awareness are not as sinister or obvious as HAL's. Instead, it's in the restraint of the narrative where I felt the strongest echoes of Kubrick's austere sci-fi epic. *Observation's* plot is incredibly compelling, with a fascinating, mind-bending sense of mystery that kept me hooked from beginning to end.

■ Andy Kelly

Verdict

A stylish, understated, and subtly chilling psychological thriller with a compelling mystery.





\$44 | PC, PS4, XB1 | WWW.APLAGUETALE.COM

A Plague Tale

Face the devastation of 14th century France.

Amicia De Rune is out on a hunt with her father and the family dog, a scene so warm and tranquil you just know things are going to go very wrong very soon. That doesn't make it any less shocking when Amicia suddenly comes face to face with the Plague, which manifests itself not only as a horrible disease, but as a teeming mass of rats that devours everything in its wake. Amicia and her father make their way home, only to find the Inquisition at their doorstep. For reasons unknown they want Amicia's little brother Hugo and are not above slaughtering their way through to him.

A *Plague Tale* starts off strong with a completely heartrending intro to the linear stealth action-adventure that sees the siblings sneak their way through the family estate while Inquisition soldiers make short work of their loved ones.

It's also an effective introduction to your tools and responsibilities. As Amicia you keep Hugo close during sneaking passages,



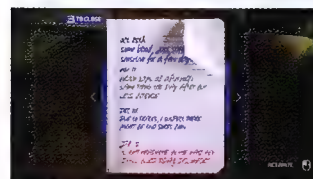
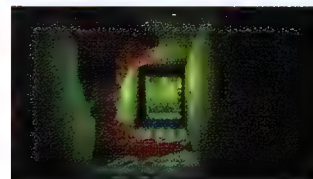
not letting go of his hand unless absolutely necessary and shielding him from the most gruesome sights. If there's climbing to be done, Hugo goes up and over first, and he helps open new passages by squeezing through openings his sister won't fit. Amicia's sling is a multipurpose item that can be used to distract soldiers by throwing stones at nearby metal items or destroy simple fastenings of drawbridges and the like.

Unfortunately your actions in *A Plague Tale* for the most part don't support the oppressive atmosphere the narrative builds, mostly because it's a game that isn't challenging to begin with, and only becomes easier.

The siblings and the friends they make along the way provide an interesting perspective on the many horrors of the 14th century, and their evolving relationship with each other is *A Plague Tale's* great draw, but the plot taking a bizarre turn towards the end makes for a botched landing at the last minute. ■ **Malindy Hetfeld**

Verdict

Beautiful and emotionally affecting.



Spek.Takl

Terror hits hardest at home.

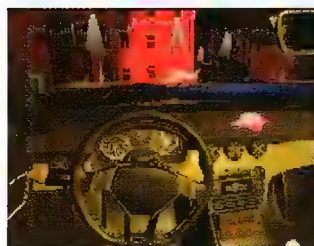
FREE | PC | BIT.LY/SPEKTGAME

In *Spek.Takl* you wake up one day in a flat that you're unable to escape from, and where a TV set plays ancient propaganda films on a loop. These freaky videos are unsettling artefacts in their own right: evidence that someone or something has been in the flat before you, or worse, that they're in it right now. But they're also a clever tool to guide the player from room to room, as clues to your next objective are hidden inside the footage.

As you investigate further – as you obey the videotapes, but also puzzle-solve by using items found in the environment – you'll finally reach its beating heart, where brick walls have transformed into pulsating flesh.

As you delve into its fleshy core, the walls begin to shudder, to warp horribly around you, as in an early PlayStation game. It's an arresting, unnerving visual effect. There are some wonderfully creepy sights, especially in the latter part of the game which is truly one of the freshest horror games in ages. ■ **Tom Sykes**





The Interlude

Ten minutes of incredible tension.

FREE | PC | CRAWLSPACESTUDIO.ITCH.IO

The Interlude will consume only ten minutes of your time, the game ending suddenly once those 600 seconds are up. Your job, as perhaps a getaway driver, is to make contact with an associate, but what you do before that happens is up to you. As you're stuck in the driver's seat, you can't get up to stretch your legs, but you can take a sip of coffee, play a game of Snake on your phone, or read your messages for a few tantalising scraps of history. Initially, the thrill is in playing with your environment, as you mess about with the wing mirrors, or flip your wipers on and off to see if you can. A few minutes later, it's in figuring out just why you're there, and what you have to do when your moment comes up. That's *The Interlude*'s master-stroke. The role you're there for will only take moments of your time, but as you don't know when it will be required of you, you're on edge for the entirety of the game. ■

Tom Sykes



\$36 | PC, MAC, XB1 | WWW.VOIDBASTARDS.COM

Void Bastards

Get bombarded by British jokes and annoying enemies.

Void Bastards is described as a strategy shooter inspired by *System Shock 2* and *BioShock*, and it features the talents of some former Irrational staff who previously made 2013's *Card Hunter*. You are a prisoner, travelling across the galaxy to fulfil the whims of an HR computer that might eventually grant you your freedom. You get across the map with an *FTL*-style interface, and while most locations are enemy spaceships that you can board, loot and escape, there are also stores, asteroid ranges and deadly hazards to be aware of. Mostly, though, your time is spent navigating ships in first-person, looking for specific items to progress, then escaping before you're killed.

While there is a stealth element to *Void Bastards* and you do have some silent weapons, it's mostly about shooting weird, British aliens in small corridors and rooms. The standard immersive sim elements are here: you can hack turrets to fight on your side, or shut down security from a



terminal on the ship. You have a dart gun.

The tools are great, and often fun to use, but the enemy types are mostly a poor fit for what you have in your inventory. Some are deliberately overpowered and meant to be avoided, which is fine. Exploding enemies that sometimes sit behind doors and blow up before you ever see them are not favourites of mine, though. It's the NPC barks that really turn me off the enemies in *Void Bastards*. One of the basic enemies shouts "surprise, buttface/twatface!" whenever you're caught by them, which I just can't stand, and the game is rife with enemies barking irritating British things.

Sometimes the game does capture the thrilling feeling of being a thief who grabs the objective, gets caught, then escapes in a hail of gunfire. Mostly, though, I found firefights just a bit of a slog, with some levels jam-packed with enemies. It'll take around 12-15 hours to finish a single run, and even after doing that, you can carry on unlocking stuff and taking on harder enemies. ■ Samuel Roberts

Verdict

A slightly messy first-person shooter elevated by a gorgeous art style.





\$39 | PC, PS4, XB1 | WWW.PATHOLOGIC-GAME.COM

Pathologic 2

The grim reaper reigns supreme in these glum streets.

Pathologic 2 is “supposed to be almost unbearable” according to devs Ice Pick Lodge, who created the obtuse, near-unplayable original *Pathologic*, and purgatorial horror game *The Void*. *Pathologic 2* challenges you to survive 12 in-game days in a town that’s going completely to hell. Disease, paranoia, mob justice, and paranormal happenings unfold in real time as you plod through brown, foggy districts, invading people’s houses for scraps and occasionally meeting important figures. It’s a deliberately exhausting experience. An egg is not just an egg in *Pathologic*, it’s an “empty illusion of

possible life”.

The survival systems constantly get in the way of a fascinating mystery game. When you chat to key figures in the town, they drop motes of information that form a growing web in your journal. Empty nodes imply there’s more to explore in a given line of enquiry.

It manages to be quite an atmospheric game, even in spite of rigid character models, static faces, sparse and repetitive interiors, and an extremely clumsy first-person combat system. The game is always pushing back against your attempts to explore, but there are delightfully macabre ideas hiding away in corners of the town, like gurgling tree

roots that drink blood and give you herbs in return. As a surgeon, you can extract organs from any corpse and then sell them to a particular buyer for food and medicine.

It’s a slog, and that’s the point of it. The suffering of your character and the townspeople is reflected in the torment of ever-hungry survival bars that drive you to theft and murder. One character talks about how her client asked her to design the town’s layout to be deliberately confusing and annoying to navigate, in order to stretch people like a spring so that, in a position of distress, they might discover deeper wells of creativity.

Though I admire the way the game keenly rejects the idea that games should always be satisfying fun factories, I just don’t see the worth in wrapping a good mystery in layers of irritant.

■ Tom Senior

Verdict

A gruelling mystery game that smothers its big ideas with dour survival mechanics.



apc
RECOMMENDS



Samurai Shodown

Gettin’ blade.

\$70 | PS4, XB1 | SNK-CORP.
CO.JP/US

A return-to-form for SNK’s decades-old 2D fighting franchise, *Samurai Shodown* is a *Street Fighter IV*-style reinvention that’s instantly accessible to newcomers while also providing enough depth for veterans. Unlike many other popular fighters, the weapons-based *Samurai Shodown* isn’t all that focused on combo systems and juggling – instead, attacks are swift and powerful, forcing players to proceed with caution in their offensive approach, lest they leave themselves open for a devastating counterattack. While the game is simple enough for button mashers to pick up and play, additional complexity comes from the ability to deflect and dodge attacks, and also in choosing the right moment to unleash a furious Super Special move or Lightning Attack, which has the capacity to kill your opponent with a single, well-timed blow. The game’s tutorials are very good and players can also sharpen their blade-wielding skills online or against the computer in a variety of modes, including one where you can fight against CPU ‘ghost’ characters based on uploaded data from other players. ■

Stephen Lambrechts





AI used to put Stallone in Terminator 2

Youtuber using Deepfakes to recast iconic films.

There have been enough controversial applications of DeepFake technologies to make it clear that it can be a powerful tool for malice if not used appropriately. One YouTuber, however, is keen to show that Deepfakes can also be a powerful tool for good by retroactively recasting iconic movies with different actors. While his latest target was to throw comedian Jim Carrey into the iconic horror thriller *The Shining*, the animation programmer known at Ctrl Alt Face has put Sylvester Stallone into *Terminator 2*, swapped the Joker from the *Dark Knight* into other Heath Ledger films and merged *Fight Club*'s narrator and Tyler Durden for an even weirder plotline.



Mob burns home of crypto Ponzi scheme founder

CRYPTO SCHEME PROMISED TO DOUBLE MONEY IN 15 DAYS.

A man believed to be behind a Bitcoin investment scheme in Ladysmith, South Africa, has found himself at the hot end of some vigilante justice by the mob he swindled. Sphelele Mbatha was accused by the mob of operating Bitcoin Wallets, a cryptocurrency investment scheme that promoted 100% investment returns in just two weeks. The arrangement turned out to be, unsurprisingly, a Ponzi scheme that was accepting close to two million Rand (\$205,000) a day at its peak. After inevitably running out of money, an angry mob of 1,500 investors amassed outside the 'Bitcoin Wallets headquarters', which also happens to be Mbatha's Ladysmith residence, and then set it on fire.

Mark Zuckerberg sponsoring Area 51 raid to free his dad from captivity

8 mins ago GENESIUS TIMES: Exavier Saskagoochie



Millions get behind Facebook group to break into Area 51

"LET'S SEE THEM ALIENS."

A Facebook event page titled 'Storm Area 51, They Can't Stop All of Us' has amassed over 1.2 million attendees, with another million parties indicating that they are interested in attending the event. While everything from the planned September 20 date to the recommended strategy of Naruto running (arms straight, head down) faster than the guard's bullets indicates it's nothing more than a gag, the level of interest prompted the US Air Force to issue a statement to *The Washington Post* saying it would discourage people from attempting to enter the active training facility. While it may not be authentic, it certainly has been catalyst for an invasion of extraterrestrial memes.

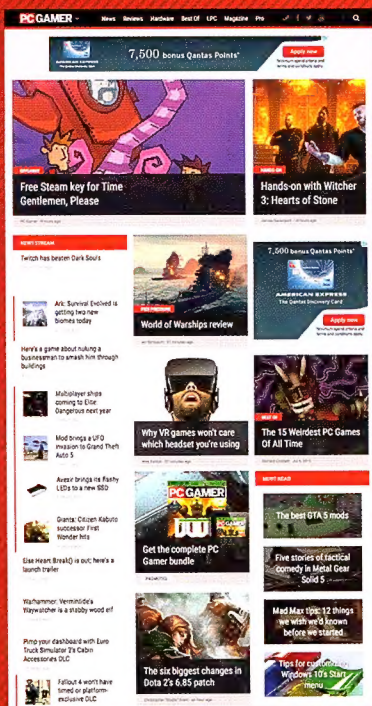


Escobar family accuse Elon Musk of stealing IP for consumer flamethrower

THE BORING COMPANY WAR WITH MEDELLIN CARTEL OVER WEAPON DESIGN.

Tesla CEO Elon Musk is never too far from controversy, but a new copyright infringement has pitted him against an opponent that is a little more dangerous than the entrepreneur is used to. Roberto Escobar, the elder brother of the late drug kingpin Pablo Escobar and head honcho at Escobar Inc., has accused The Boring Company founder of stealing the design for a consumer flamethrower that was released at the beginning of 2018. The Boring Company sold its limited 20,000-unit run within the first month of sales and hasn't released additional units since, so we suspect Escobar Inc. is just stealing a little of Musk's thunder (and fire) to make a buck.

SMARTER COOKIES ENABLED



JOIN US ONLINE AT
WWW.PCGAMER.COM



Designed to push
creativity further



WITH THE NEW UltraFine™
32" Class 4K Ultra HD Nano IPS Monitor

IPS VESA Display HDR 600 and 98% DCI-P3 Digital Cinema Colour Standard offer accurate shadow detail, colour, saturation and brightness for precise editing and post production.

lg.com/au/uhd-4k-monitors

32UL950



Unlimit Your Performance